5-4320-218-15

TM 5-4320-218-15

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR, ORGANIZATIONAL, FIELD AND DEPOT MAINTENANCE MANUAL

PUMP, CENTRIFUGAL PETROLEUM

GASOLINE DRIVEN, TRAILER MTD
4 IN., 350 GPM, 275 FT HEAD
(GORMAN RUPP MODEL 04A12-MVG4D)
FSN 4320-691-1071

This copy is a reprint which includes current pages from Changes 1, 4, 8, 9, and 10.

HEADQUARTERS, DEPARTMENT OF THE ARMY
MARCH 1961

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SAFETY PRECAUTIONS

When handling gasoline, always provide a metal-to-metal contact between the container and the tank. This will prevent a spark from being generated as fuel flows over the metallic surfaces.

Be extremely careful when using a carbon tetrachloride fire extinguisher in an enclosed area. A poisonous gas is generated by the contact of carbon tetrachloride with a heated metallic surface. Provide adequate ventilation before entering an enclosed area where carbon tetrachloride has been used.

When fighting fires with a monobromotrifluomethane fire extinguisher, avoid breathing of smoke. Rules prohibiting smoking must be established and strictly enforced. Adequate NO SMOKING signs must be prominently posted.

Do not operate the pump in an enclosed building unless the exhaust gases are piped to the outside. Exhaust gases contain carbon monoxide which is a colorless, odorless, and poisonous gas.

See that the pump is grounded before operating. Ungrounded units may produce sparks which will ignite gasoline vapors, causing destruction of materiel and serious injury or death to personnel.

Clean all traces of gasoline from the fuel tank prior to soldering or welding. Failure to observe this precaution may result in an explosion.

TECHNICAL MANUAL

Operator, Organizational, Field and Depot Maintenance Manual

PUMP, CENTRIFUGAL: PETROLEUM; GASOLINE DRIVEN; TRAILER MOUNTED 4 IN. 350 GPM, 275 FT HEAD (GORMAN RUPP MODEL 04A12-MVG4D)

FSN 4320-691-1071

TM 5-4320-218-15
CHANGES No. 1

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., *9 July 1963*

TM 5-4320-218-15, 2 March 1961, is changed as follows:

Page 2. After CHAPTER 5, add the following:

CHAPTER 6. SHIPMENT AND LIMITED STORAGE.

Section I. Shipment within zone of interior
II. Limited Storage

Page 3. Paragraph 1.

c. (Added) Report all deficiencies in this manual on DA Form 2028. Submit recommendations for changes, additions, or deletions to the Commanding Officer, U. S. Army Mobility Support Center, ATTN: SMOMS-MS, P. O. Box 119, Columbus 16, Ohio. Direct communication is authorized.

d. (Added) Report all equipment improvement recommendations as prescribed by TM 38-750.

2. Record and Report Forms
(Superseded)

a. DA Form 2258 (Depreservation Guide of Engineer Equipment).

b. For other record and report forms applicable to the operator and organizational maintenance, refer to TM 38-750.

Note. Applicable forms, excluding Standard Form 46, which is carried by the operator, shall be kept in a canvas bag mounted on the equipment.

Page 12. Paragraph 12*b*. After *Starting*, add note as follows:

Note. Perform the daily preventive maintenance services (par. 27).

Page 21.

26. General
(Superseded)

To insure that the centrifugal pump is ready for operation at all times, it must be inspected systematically, so that defects may be discovered and corrected before they result in serious damage or failure. The necessary Preventive Maintenance Services to be performed are listed and described in paragraphs 27 and 29. The item numbers indicate the sequence of minimum inspection requirements. Defects discovered during operation of the unit shall be noted for future correction, to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noted during operation which would damage the equipment if operation were continued. All deficiencies and shortcomings will be recorded, together with the corrective action taken, on DA Form 2404 at the earliest possible opportunity.

Page 21.

27. Daily Preventive Maintenance Services
(Superseded)

This paragraph contains an illustrated tabulated listing of preventive maintenance services which must be performed by the operator. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to Figure 8.1 for the Daily Preventive Maintenance Services.

Page 23.

29. Quarterly Preventive Maintenance Services

(Superseded)

a. This paragraph contains an illustrated tabulated listing of preventive maintenance services which must be performed by Organizational Maintenance personnel at quarterly intervals. A quarterly interval is equal to 3 calendar months, or 250 hours of operation, whichever occurs first.

b. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to Figure 8.2 for the Quarterly Preventive Maintenance Services.

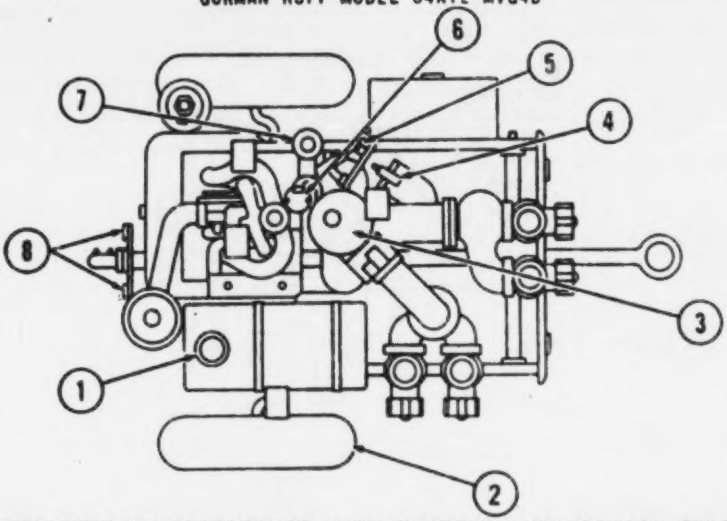
PREVENTIVE MAINTENANCE SERVICES

DAILY

TM5-4320-218-15

PUMP

GORMAN RUPP MODEL 04A12-MVG4D



LUBRICATE IN ACCORDANCE WITH CURRENT LUBRICATION ORDER

ITEM		PAR REF
1	FUEL TANK AND FILTER. Add fuel as required. Clean filter as required.	
2	TIRES. Check for damaged, cut, or excessively worn tires. Proper tire pressure is 45 pounds. (Weekly)	
3	PUMP. Check for leaks and damage.	
4	PUMP STRAINER. Clean a clogged strainer.	
5	CONTROLS AND INSTRUMENTS. Check for damaged or defective gages.	9
6	FUEL STRAINER. Drain sediment. (Weekly)	
7	OIL LEVEL GAGE. Add oil as indicated by level gage. Reference current L.O.	
8	REFLECTORS. Check for damage.	
	NOTE 1. OPERATION. During operation observe for any unusual noise or vibration.	
	NOTE 2. FIRE EXTINGUISHER. Check for broken seal.	

MSC 4320-218 15 8.1

Figure 8.1. (Added) Daily preventive maintenance services.

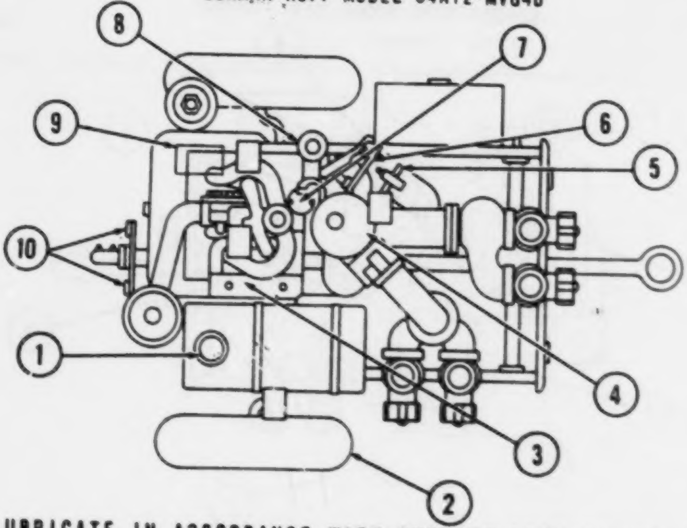
PREVENTIVE MAINTENANCE SERVICES

QUARTERLY

TM5-4320-218-15

GORMAN RUPP MODEL 04A12-MVG40

PUMP



LUBRICATE IN ACCORDANCE WITH CURRENT LUBRICATION ORDER

ITEM		PAR REF
1	FUEL TANK AND FILTER. Add fuel as required. Replace leaking fuel tank. Replace defective cap gasket. Clean cap vent. Replace defective filter.	56
2	TIRES AND WHEELS. Replace damaged, cut, or excessively worn tires. Proper tire pressure is 45 pounds. Replace damaged wheel.	73
3	SPARK PLUGS AND WIRING. Replace defective wiring and spark plugs. Clean and set spark plug gap for 0.030 inch. Torque spark plugs to 25 to 30 ft-lb.	67 68
4	PUMP. Check for leaks and damage.	
5	PUMP STRAINER. Replace damaged strainer.	
6	CONTROLS AND INSTRUMENTS. Replace damaged or defective gages. Tighten loose mountings.	9
7	FUEL STRAINER. Replace damaged fuel strainer.	53
8	OIL LEVEL GAGE. Add oil as indicated by level gage. Reference current L.O.	
9	MAGNETO. Replace a defective magneto. Replace pitted or burned breaker points. Proper gap adjustment is 0.015 inch. (Check adjustment every 500 hours.)	66

Figure 8.2. (Added) *Quarterly preventive maintenance services.*

ITEM		PAR REF
10	REFLECTORS. Replace damaged reflectors.	
	NOTE 1. OPERATIONAL TEST. During operation observe for any unusual noise or vibration.	
	NOTE 2. ADJUSTMENTS. Make all necessary adjustments during operational test.	
	NOTE 3. FIRE EXTINGUISHER. Check for broken seal. Weigh the new and fully charged monobromotrifluoromethane fire extinguisher and enter weight on inspection record. Weigh every 3 months thereafter If the gross weight has decreased 4 ounces or more, replace cylinder	

MSC 4320-218-15/8.2

Figure 8.2—Continued.

CHAPTER 6

SHIPMENT AND LIMITED STORAGE
(Added)

Section I. SHIPMENT WITHIN ZONE OF INTERIOR

147. Preparation of Equipment for Shipment

a. General. Detailed instructions for the preparation of U. S. Army Mobility Command equipment for domestic shipment are outlined within this paragraph. Preservation will be accomplished in sequence that will not require the operation of previously preserved components.

b. Inspection. Equipment will be inspected for any unusual conditions such as damage, rusting, accumulation of water, and pilferage. DA Form 2404, Equipment Inspection and Maintenance Worksheet, will be executed on the equipment.

c. Cleaning and Drying. Thorough cleaning and drying by an approved technique is the first essential procedure in any effective preservation process. Approved methods of cleaning, drying, types of preservatives, and methods of application are described in TM 38–230.

d. Painting. Paint all surfaces when the paint has been removed or damaged. Refer to TB ENG 60 for detailed cleaning and painting instructions.

e. Depreservation Guide. A properly annotated DA Form 2258, Depreservation Guide of Engineer Equipment, will be completed concurrently with preservation of each centrifugal pump. Any special requirements will be outlined in blocks 27 through 33. The completed depreservation guide will be placed in a waterproof envelope marked "Depreservation Guide," and secured in a conspicuous location near the operational controls.

f. Lubrication System. Check level of lubricant. Operate engine at fast idle until lubricant has been circulated throughout the system. The crankcase will then be drained and the drain plugs reinstalled.

g. Sealing of Openings. Openings that will permit the direct entry of water into the interior of gasoline-engine driven equipment, electric motors, and so forth, shall be sealed with pressure-sensitive tape conforming to Specification PPP–T–60, type III, class 1.

h. Fuel Tanks. Drain fuel tank after engine preservation and fog interior with preservative oil, type P–10, grade 2, conforming to Specification MIL–L–21260.

i. Air Cleaners. Drain the air cleaner and seal all openings that permit the direct entry of water. Use type III, class 1, waterproof pressure-sensitive adhesive tape conforming to PPP–T–60.

j. Exterior Surfaces. Coat exposed machined ferrous metal surfaces with GAA Grease, Automotive and Artillery.

k. Marking. Shall conform to MIL–STD–129.

l. Disassembly, Disassembled Parts, and Basic Issue Items.

(1) Disassembly shall be limited to the removal of parts and projecting components, exhaust pipe and auxiliary fuel line.

(2) Pack the disassembled parts and basic issue items in a suitable container and secure to the centrifugal pump or crate base.

m. Packing. Pack the centrifugal pump, basic issue items, and disassembled parts in a suitable container. Refer to TM 38–230 for guidance in fabricating and packing the container.

148. Loading Equipment for Shipment

a. Load the centrifugal pump on the carrier, using a suitable lifting device.

b. Place suitable blocking in front of and behind wheels to prevent shifting, and secure the centrifugal pump to the carrier.

Section II. LIMITED STORAGE

149. Preparation of Equipment for Storage

a. General. Detailed instructions for preserving and maintaining equipment in limited storage are outlined in this paragraph. Limited storage is defined as storage not to exceed 6 months. Refer to AR 743–505.

b. Inspection. Equipment will be inspected for any unusual condition such as damage, rusting, accumulation of water, and pilferage. DA Form 2404, Equipment Inspection and Maintenance Worksheet, will be executed on the equipment.

c. Cleaning and Drying. Thorough cleaning and drying by an approved technique is the first essential procedure in any effective preservation process. Approved methods of cleaning, drying, types of preservatives, and methods of application are described in TM 38–230.

d. Painting. Paint all surfaces when the paint has been removed or damaged. Refer to TB ENG 60 for detailed cleaning and painting instructions.

e. Depreservation Guide. A properly annotated DA Form 2258, Depreservation Guide of Engineer Equipment, will be completed concurrently with preservation of each centrifugal pump. Any special requirements will be outlined in blocks 27 through 33. The completed depreservation guide will be placed in a waterproof envelope marked "Depreservation Guide" and secured in a conspicuous location near the operational controls.

f. Sealing of Openings. Openings that will permit the direct entry of water into the interior of the equipment shall be sealed with pressure-sensitive tape conforming to Specification PPP–T–60, type III, class 1.

g. Fuel Tanks. Drain fuel tank after engine preservation and fog interior with preservative oil, type P–10, grade 2, conforming to Specification MIL–L–21260.

h. Exterior Surfaces. Coat exposed machined ferrous metal surfaces with GAA Grease, Automotive and Artillery.

i. Disassembly, Disassembled Parts, and Basic Issue Items.

(1) Disassembly shall be limited to the removal of parts and projecting components that interfere with storage of the equipment and that which is subject to pilferage.

(2) Pack the basic issue items and disassembled parts in a suitable container and secure with the centrifugal pump to prevent loss or pilferage.

j. Weatherproofing. When suitable shelter is not available, select a firm, level, well-drained storage location, protected from prevailing winds. Position the equipment on heavy planking or other solid surfaces. Cover the equipment with a paulin or other suitable waterproof covering and tie down securely.

150. Inspection and Maintenance of Equipment in Storage

a. Inspection. When the centrifugal pump has been placed in storage, all scheduled preventive maintenance services, including inspection, will be suspended and preventive maintenance inspection will be performed as specified herein. Refer to AR 743–505.

b. Worksheet and Preventive Maintenance. Applicable forms listed in TM 38–750 shall be prepared for each major item of equipment when initially placed in limited storage, in accordance with the scheduled interval contained in AR 743–505. Perform required maintenance promptly to make sure equipment is mechanically sound and ready for immediate use.

c. Operation. Operate equipment in limited storage long enough to bring it up to operating temperature and to insure complete lubrication of all bearings, gears, and the like, in accordance with the scheduled interval contained in AR 743–505. Equipment must be serviced and in satisfactory operating condition before it is operated.

Page 91. Paragraph 5. Delete "AR 700–38, Unsatisfactory Equipment Report."

After TM 9–1870–1, Care and Maintenance of Pneumatic Tire, Add:

TM 38–750 The Army Equipment Record System and Procedures.

Page 102.

4. Comments and Suggestions (Superseded)

Suggestions and recommendations for changes to the Basic Issue Items List will be submitted on DA Form 2028 to the Commanding Officer, U. S. Army Mobility Support Center, ATTN: SMOMS–MS, P. O. Box 119, Columbus 16, Ohio. Direct communication is authorized.

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By Order of the Secretary of the Army:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

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MAAG (1)
JBUSMC (1)
Units org under fol TOE:
  5–48 (2)
  5–237 (5)
  5–262 (5)
  5–267 (1)
  5–278 (5)
  5–279 (2)

NG: None.

USAR: Same as active army except allowance is one copy to each unit.

For explanation of abbreviations used see AR 320–50.

Changes in force C 1 and C 4

***TM 5-4320-218-15**
C 4

CHANGE No. 4 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *11 February 1969*

Operator, Organizational, Field and Depot Maintenance Manual

PUMP, CENTRIFUGAL PETROLEUM; GASOLINE DRIVEN, TRAILER MOUNTED, 4 IN., 350 GPM, 275 FT. HEAD (GORMAN-RUPP MODEL 04A12-MVG4D) FSN 4320-691-1071, (GORMAN-RUPP MODEL 04A12B-MVG4D) FSN 4320-069-8494

TM 5-4320-218-15, 2 March 1961, is changed as follows:

Cover page and title page. Add (Gorman-Rupp Model 04A12B-MVG4D) FSN 4320-069-8494 after FSN 4320-691-1071.

Page 3. Paragraph 1*a* is superseded as follows:

a. This manual contains instructions for the use of operating, organizational, direct and general support, and depot personnel maintaining the 350 gpm centrifugal pump as allocated by the Maintenance Allocation Chart. It provides information of the operation, lubrication, preventive maintenance services, troubleshooting and maintenance of the equipment, its accessories, components, and attachments.

Paragraph 2 is superseded as follows:

2. Forms and Records

a. DA Forms and records used for equipment maintenance will be only those prescribed in TM 38-750.

b. Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to the Commanding General, U. S. Army Mobility Equipment Command, ATTN: AMSME-MPP, 4300 Goodfellow Boulevard, St. Louis, Mo. 63120.

Paragraph 3 is superseded as follows:

3. Description

The 350 gpm centrifugal pump, Gorman-Rupp Models 04A12-MVG4D and 04A12B-MVG4D (fig. 1 and 2) are self-contained, self-priming units designed for pumping gasoline, jet fuel, diesel fuel, light liquid petroleum fuel, and water. The pump is powered by a four cylinder air cooled gasoline engine, Wisconsin Model MVG4D.

Note. Never operate the pump with any part of the engine shrouding removed, because this will retard the air cooling.

Page 4. Paragraph 5*a* is superseded as follows:

a. General.

Note. Unless otherwise indicated, data pertains to both models.

Length overall:	
Model 04A12-MVG4D	102 in.
Model 04A12B-MVG4D	120 in.
Length (tow bar retracted):	
Model 04A12-MVG4D	75 in.
Model 04A12B-MVG4D	72½ in.
Width	57 in.
Height	56 in.
Weight	1235 lbs.
Tire size	7.00 .. 16
Tire pressure	25 to 30 psi

Paragraph 5*b*, under Horsepower add:

36 at	2400 rpm

Under Carburetor, supersede as follows:

Carburetor:	
Manufacturer	Marvel-Schebler
Model 04A12-MVG4D	VH-69-A
Model 04A12B-MVG4D	L-54-J3

Under Air Cleaner, supersede as follows:

Air Cleaner:	
Manufacturer	Donaldson Co.
Model 04A12-MVG4D	A-A552
Model 04A12B-MVG4D	MS35785-3

Page 91. Appendix I is superseded as follows:

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*This change supersedes C 2, 23 July 1964 and C 3, 19 March 1965.

APPENDIX I

REFERENCES

1. Fire Protection

TB 5-4200-200-10	Hand Portable Fire Extinguishers for Army Users

2. Lubrication

C9100-IL	Fuels, Lubricants, Oils and Waxes

3. Painting

TM 9-213	Painting Instructions for Field Use

4. Radio Suppression

TM 11-483	Radio Interference Suppression

5. Maintenance

TM 5-4320-218-20P	Organizational Maintenance Repair Parts and Special Tool Lists
TM 5-4320-218-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists
TM 9-1870-1	Care and Maintenance of Pneumatic Tires
TM 9-6140-200-15	Operation and Organizational, Field and Depot Maintenance Storage Batteries, Lead Acid Type
TM 38-750	Army Equipment Record Procedures
TB ORD 651	Use of Antifreeze Solutions and Cleaning Compounds in Engine Cooling System

6. Shipment and Storage

TB 740-90-1	Administrative Storage of Equipment
TB 740-93-2	Preservation of USAMEC Mechanical Equipment for Shipment and Storage

Pages 93 thru 99. Appendix II is superseded as follows:

APPENDIX II

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

1. General

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III — Not applicable.

d. Section IV contains supplemental instructions, explanatory notes and/or illustrations required for a particular maintenance function.

2. Explanation of Columns in Section II

a. Group Number, Column (1). The functional group is a numerical group set up on a functional basis. The applicable functioning grouping indexes (obtained from TB 750-93-1, Functional Grouping Codes) are listed on the MAC in the appropriate numerical sequence. These indexes are normally set up in accordance with their function and proximity to each other.

b. Function Group, Column (2). This column contains a brief description of the components of each functional group.

c. Maintenance Functions, Column (3). This column lists the various maintenance functions (A through K) and indicates the lowest maintenance category authorized to perform these functions. The symbol designations for the various maintenance categories are as follows:

C	Operator or crew
O	Organizational maintenance
F	Direct support maintenance
H	General support maintenance
D	Depot maintenance

The maintenance functions are defined as follows:

A Inspect: To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

B Test: To verify serviceability and to detect electrical or mechanical failure by use of test equipment.

C Service: To clean, to preserve, to charge, to paint, and to add fuel, lubricants, cooling agents, and air.

D Adjust: To rectify to the extent necessary to bring into proper operating range.

E Aline: To adjust specified variable elements of an item to bring to optimum performance.

F Calibrate: To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard

G Install: To set up for use in an operational environment such as an emplacement, site, or vehicle.

H Replace: To replace unserviceable items with serviceable assemblies, subassemblies, or parts.

I Repair: To restore an item to serviceable condition. This includes, but is not limited to, inspection, cleaning, preserving, adjusting, replacing, welding, and strengthening.

J Overhaul: To restore an item to a completely serviceable condition as prescribed by maintenance serviceability standards using the Inspect and Repair Only as Necessary (IROAN) technique.

K Rebuild: To restore an item to a standard as nearly as possible to original or new condition in appearance, performance and life expectancy. This is accomplished through complete disassembly of the item, inspection of all parts or components, repair or replacement of worn or unserviceable elements (items) using original manufacturing tolerances and specifications, and subsequent reassembly of the item.

d. Tools and Equipment, Column (4). This column is provided for referencing by code the special tools and test equipment (sec. III) required to perform the maintenance functions (sec. II).

e. Remarks, Column (5). This column is provided for referencing by code the remarks (sec. IV) pertinent to the maintenance functions.

3. Explanation of Columns in Section IV

a. Reference Code. This column consists of two letters separated by a dash, both of which are references to Section II. The first letter references Column 5 and the second letter references a maintenance function, Column 3, A through K.

b. Remarks. This column lists information pertinent to the maintenance function being performed, as indicated on the MAC, Section II.

Section II. MAINTENANCE ALLOCATION CHART

(1) Group No.	(2) Functional group	(3) Maintenance functions											(4) Tools and equipment	(5) Remarks
		A	B	C	D	E	F	G	H	I	J	K		
		Inspect	Test	Service	Adjust	Aline	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
01	ENGINE													
0100	Engine Assembly	C	O	C					F	O	H			A
0101	Crankcase, Block, Cylinder Head:													
	Crankcase assembly								H	H				B
	Cylinder block assembly								F	F				
	Cylinder head	O							O					
0102	Crankshaft:													
	Crankshaft assembly								H	D				C
	Seals								F					
0103	Flywheel Assembly	O							O					
0104	Pistons, Connecting Rods								H	H				
0105	Valves, Camshaft, and Timing System:													
	Valves: seats								F	F				D
	Cover tappet	O							O					
	Valve tappet assembly				O				F					
	Camshaft	H							H					
	Gears, timing	H							H					
0106	Engine Lubrication System:													
	Oil pump								F	F				
	Filter assembly, oil			C					O					
	Breather			C					O					
	Line assemblies								O	O				
0107	Engine Starting System:													
	Crank, hand	C							O					
0108	Manifolds	O							O					
03	FUEL SYSTEM													
0301	Carburetor		O	C					O					
0302	Fuel Pump	O							O					
0304	Air Cleaner			C					O					
0306	Tanks, Lines, Fittings:													
	Line assembly								O	O				
	Tank, fuel			C					O	O				
0308	Engine Speed Governor and Controls:													
	Governor assembly								O	H				
	Rod, control			O					O					
0309	Fuel Filter:													
	Strainer assembly, fuel			C					O					
0311	Engine Starting Aids	O							O					
0312	Throttle or Choke Controls			O					O					

04	**EXHAUST SYSTEM**												
0401	Muffler and Pipes	O							O				
05	**COOLING SYSTEM**												
0502	Deflectors, Shrouds	O							O				
06	**ELECTRICAL SYSTEM**												
0605	Ignition Components:												
	Magneto assembly			O	O				O	O	F		
	Spark plug		O	O	O				O				
0607	Engine Control Panel								O	O			
0615	Radio Interference Suppression:												
	Lead, ground	O							O				
11	**REAR AXLE**												
1100	Rear Axle Assembly								O	O			
13	**WHEELS**												
1311	Wheel Assembly			C					O	O			
1313	Tires, Tubes			C					O	O			
15	**FRAME, TOWING ATTACHMENTS AND DRAWBARS**												
1501	Frame Assembly:												
	Bail lifting	O							O				
	Frame assembly	F							F				
1503	Pintles and Towing Attachments:												
	Hook assembly			C					O	O			
	Tongue, towing	O							O				
1507	Leveling Jacks	O							O				
18	**BODY, CAB, HOOD AND HULL**												
1808	Boxes	O							O				
22	**BODY, CHASSIS OR HULL, AND ACCESSORY ITEMS**												
2201	Canvas Items	C							C				
2202	Accessory Items:												
	Reflectors	O							D				
2210	Data Plates:												
	Plate, Data (A.I.P.)	F							F				
	Plate, Instruction	O							O				
47	**GAGES**												
4701	Instrument:												
	Adapter, shaft, drive			C					O				
	Tachometer; shaft assembly								O				
4702	Gages, Mountings, Lines and Fittings	O							O				
55	**PUMPS**												
5500	Pump Assembly:												
	Pump Assembly	C		C					F	F	H		
5501	Shafts, Rotors, Impellers	F							F				
5505	Suction and/or Discharge Assembly:												
	Eliminator Assembly			C					O	O			
5510	Inlet and Outlet Components:												
	Adapter; Coupler; Fittings; Manifolds; Plug, Dust	O							O				
	Valve Assembly, Check and Gate								O	F			

Section II. MAINTENANCE ALLOCATION CHART—Continued

(1)	(2)	(3)											(4)	(5)
		Maintenance functions												
		A	B	C	D	E	F	G	H	I	J	K		
Group No.	Functional group	Inspect	Test	Service	Adjust	Aline	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	Tools and equipment	Remarks
76	FIRE FIGHTING EQUIPMENT													
7603	Fire Extinguisher			C					C	C				

Section IV. REMARKS

Reference code	*Remarks*
A—B	Test of Engine includes compression and operation.
B—I	Repair of Crankcase Assembly includes reboring Cylinders.
C—I	Repair of Crankshaft Assembly includes metalizing, regrinding and balancing.
D—I	Repair of Valves and Seats includes refacing.

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:
KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

Distribution:

To be distributed in accordance with DA Form 12-25, Section I, (qty rqr block no. 246) organizational maintenance requirements for Pumps, Centrifugal: Petroleum.

Changes in force: C1, C4, C7 and C8

TM 5-4320-218-15
C8

CHANGE No. 8

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *5 April 1974*

Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual

PUMP, CENTRIFUGAL, PETROLEUM; GASOLINE DRIVEN, TRAILER MOUNTED, 4 IN., 350 GPM, 275 FT. HEAD (GORMAN-RUPP MODEL 04A12-MVG4D) FSN 4320-691-1071 (GORMAN-RUPP MODEL 04A12B-MVG4D) FSN 4320-069-8494

TM 5-4320-218-15, 2 March 1961, is changed as follows:

Inside Front Cover. Add the following warning to the list of safety precautions:

WARNING

Operation of this equipment presents a noise hazard to personnel in the area. The noise level exceeds the allowable limits for unprotected personnel. Wear ear muffs or ear plugs which were fitted by a trained professional.

Page 3. Paragraph 1c is added as follows:

c. You can help to improve this manual by calling attention to errors and by recommending improvements. Your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) should be mailed direct to: Commander, US Army Troop Support Command, ATTN: AMSTS-MPP, 4300 Goodfellow Blvd., St. Louis, MO 63120. A reply will be furnished directly to you.

Page 12. Immediately after the section III title, add the following warning:

WARNING

Operation of this equipment presents a noise hazard to personnel in the area. The noise level exceeds the allowable limits for unprotected personnel. Wear ear muffs or ear plugs which were fitted by a trained professional.

Page 72. Paragraph 112*c* is superseded as follows:

c. Measure the cylinder bores with an inside micrometer. Measure the bore lengthwise and crosswise above the ring travel; repeat the measurement at the top of the ring travel. The difference in these measurements will determine the amount of wear in the cylinder bore, the taper, and out-of-round condition. If cylinder bores are worn more than 0.008 inch, replace the cylinder block assembly and pistons assemblies.

Page 73. Paragraph 114*f* is superseded as follows:

f. Invert the piston and slide it into the cylinder bore. Check the piston-to-cylinder clearance at the piston skirt thrust faces. The clearance should be 0.005 to 0.006 inch. If it is greater, replace the cylinder block assembly and the piston assemblies.

Page 91, paragraph 5. Appendix I, References, add the following:

TB MED 251	Noise and Conservation of Hearing

By Order of the Secretary of the Army:

CREIGHTON W. ABRAMS
General, United States Army
Chief of Staff

Official:
VERNE L. BOWERS
Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-25A, (qty rqr block No. 154) Operator Maintenance Requirements for Petroleum Distribution.

Changes in force: C1, C4, C8 and C9

TM 5-4320-218-15
C9

CHANGE

NO. 9

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., ***16 December 1977***

Operator, Organizational, Field and Depot Maintenance Manual

PUMP, CENTRIFUGAL PETROLEUM; GASOLINE DRIVEN, TRAILER MOUNTED, 4 IN., 350 GPM, 275 FT. HEAD (GORMAN-RUPP MODEL 04A12-MVG4D) NSN 4320-00-691-1071, (GORMAN-RUPP MODEL 04A12B-MVG4D) NSN 4320-00-069-8494

TM 5-4320-218-15, 2 March 1961, is changed as follows:

Page 2, line 4 Table of Contents is changed to read:

APPENDIX A. References A-1
B. Components of End Item List B-1
C. Maintenance Allocation Chart C-1
D. Expendable Supplies and Materials List D-1

Page 19, delete "OE10 and OES" oil and add "OEA/APG-PD-1".

Page 91, change Appendix I to Appendix A.

Page 92, add "Appendix B. Components of End Items List" and change Appendix II to Appendix C. After Appendix C add Appendix D. Expendable Supplies and Materials List.

APPENDIX B
COMPONENTS OF END ITEMS LIST
Section I. INTRODUCTION

B-1. Scope

This appendix lists integral components of and basic issue items for the Petroleum Centrifugal Pump to help you inventory items required for safe and efficient operation.

B-2. General

The Components of End Item List is divided into the following sections:

a. Section II. Integral Components of the End Item. These items, when assembled, comprise the Pump and must accompany it whenever it is transferred or turned in. These illustrations will help you identify these items.

b. Section III. Basic Issue Items. These are minimum essential items required to place the Pump in operation, to operate it, and to perform emergency repairs. Although shipped separately packed they must accompany the Pump during operation and whenever it is transferred between accountable officers. The illustrations will assist you with hard-to-identify items. This manual is your authority to requisition replacement BII, based on Table(s) of Organization and Equipment (TOE)/Modification Table of Organization and Equipment (MTOE) authorization of the item.

B-3. Explanation of Columns

a. Illustration. This column is divided as follows:

(1) Figure Number. Indicates the figure number of the illustration on which the item is shown (if applicable).

(2) Item Number. The number used to identify item called out in the illustration.

b. National Stock Number (NSN). Indicates the National stock number assigned to the item and which will be used for requisitioning.

c. Part Number (P/N). Indicates the primary number used by the manufacturer, which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of items.

d. Description. Indicates the Federal item name and, if required, a minimum description to identify the item.

e. Location. The physical location of each item listed is given in this column. The lists are designed to inventory all items in one area of the major item before moving on to an adjacent area.

f. Usable on Code. "USABLE ON" codes are included to help you identify which component items are used on the different models. Identification of the codes used in these lists are:

CODE	*USED ON*
PCA	Model 04A12B-MVG4D
PCB	Model 04A12-MVG4D

g. Quantity Required (Qty Reqd). This column lists the quantity of each item required for a complete major item.

h. Quantity. This column is left blank for use during inventory. Under the Rcv'd column, list the quantity you actually receive on your major item. The Date columns are for use when you inventory the major item at a later date; such as for shipment to another site.

Section II. INTEGRAL COMPONENTS OF END ITEM

(1) ILLUSTRATION (a) FIGURE NO.	(b) ITEM NO.	(2) NATIONAL STOCK	(3) PART NO. &	(4) DESCRIPTION FSCM	(5) LOCATION	(6) USABLE CODE	(7) ON REQD	(8) QUANTITY RCVD	QTY DATE	DATE	DATE
		5975-00-878-3791	13763 (25567)	Ground Rod Assembly	NAR		1				
4	6	3805-00-930-5758	U230H (66289)	Crank, Start	NAR	B	1				
4	6	2815-00-986-2000	U226A (66289)	Crank, Start	Y11	A	1				

Section III. BASIC ISSUE ITEMS

(1) ILLUSTRATION (a) FIGURE NO	(b) ITEM NO.	(2) NATIONAL STOCK NO.	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQD	(8) QUANTITY RCVD	DATE	DATE	DATE
				LO5-4320-218-12			1				
				TM5-4320-218-15			1				
		5120-00-449-8083		Wrench; Open End, Adjustable			1				
		5120-00-900-6103		Hammer, Hand			1				
		4210-00-881-0531		Fire Extinguisher			1				

APPENDIX D
EXPENDABLE SUPPLIES AND MATERIALS LIST
Section I. INTRODUCTION

D-1. Scope

This appendix lists expendable supplies and materials you will need to operate and maintain the Pump. These items are authorized to you by CTA50-970, Expendable Items (except Medical, Class V, Repair Parts, and Heraldic Items).

D-2. Explanation of Columns

a. Column 1 - Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound, Item 5, App. D").

b. Column 2 - Level. This column identifies the lowest level of maintenance that requires the listed item. (enter as applicable:)

C - Operator/Crew
F - Direct Support Maintenance
O - Organizational Maintenance
H-General Support Maintenance

c. Column 3 - National Stock Number. This is the National stock number assigned to the item; use it to request or requisition the item.

d. Column 4 - Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the part number followed by the Federal Supply Code for Manufacturer (FSCM) in parenthesis, if applicable.

e. Column 5 - Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
		6850-00-281-1985	Solvent, Cleaning	gal
		9150-00-402-4478	Oil, Engine, Subzero	qt
		9150-00-186-6681	Oil, Engine, EOSO	qt
		9130-00-160-1818	Gasoline	bulk

By Order of the Secretary of the Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Brigadier General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-25A, Operator's maintenance requirements for Petroleum Distribution.

Changes in force: C1, C4, C8, C9, and C10

TM 5-4320-218-15
C10

CHANGE
No. 10

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 12 January 1981

Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual

PUMP CENTRIFUGAL, PETROLEUM; GASOLINE DRIVEN, TRAILER MOUNTED, 4 IN., 350 GPM, 275 FEET HEAD
(GORMAN-RUPP MODEL 04A12-MVG4D) NSN 4320-691-1071
(GORMAN-RUPP MODEL 04A12B-MVG4D) NSN 4320-069-8494

TM 5-4320-218-15, 2 March 1961, is changed as follows:

Page 12. Immediately following subparagraph 12***a***.(4), add the following Warning:

WARNING

After removing the priming cap and filling the pump casing with the product to be pumped, check the snap-in gasket in the cap to be sure that it is present and that it is serviceable (No dents; cuts, abrasions). Remove and replace as necessary.

When the casing has been filled, place the cap on the male quick disconnect adapter and raise the cam levers on the cap to the fully locked (vertical) position.

Bind the cap cam levers together in the locked position with soft wire or heavy twine in order to eliminate any possibility of their release due to vibration. This procedure must be followed each time the pumping assembly is primed.

Page 22. Immediately following subparagraph 27***c***.(6), add the following Warning:

WARNING

After removing the priming cap and filling the pump casing with the product to be pumped, check the snap-in gasket in the cap to be sure that it is present and that it is serviceable (No dents; cuts, abrasions). Remove and replace as necessary.

When the casing has been filled, place the cap on the male quick disconnect adapter and raise the cam levers on the cap to the fully locked (vertical) position.

Bind the cap cam levers together in the locked position with soft wire or heavy twine in order to eliminate any possibility of their release due to vibration. This procedure must be followed each time the pumping assembly is primed.

Page 23. Immediately following subparagraph 28***g***.(4), add the following Warning:

WARNING

After removing the priming cap and filling the pump casing with the product to be pumped, check the snap-in gasket in the cap to be sure that it is present and that it is serviceable (No dents; cuts, abrasions). Remove and replace as necessary.

When the casing has been filled, place the cap on the male quick disconnect adapter and raise the cam levers on the cap to the fully locked (vertical) position.

Bind the cap cam levers together in the locked position with soft wire or heavy twine in order to eliminate any possibility of their release due to vibration. This procedure must be followed each time the pumping assembly is primed.

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Major General, United States Army
The Adjutant General

DISTRIBUTION:

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This manual contains copyrighted material

TECHNICAL MANUAL
No. 5-4320-218-15

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *2 March 1961*

Operator, Organizational, Field, and Depot Maintenance Manual

PUMP, CENTRIFUGAL: PETROLEUM; GASOLINE DRIVEN; TRAILER MOUNTED 4 IN. 350 GPM, 275 FT HEAD (GORMAN RUPP MODEL 04A12-MVG4D)

FSN 4320-691-1071

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual applies to the Pump, Centrifugal, Trailer Mounted. It includes a description, data, operation, maintenance, and field and depot maintenance.

b. Repair parts are listed in TM 5-4320-218-20P and TM 5-4320-218-35P.

2. Records and Report Forms

For Blank forms that may be used in the preparation of records, reports, and requisitions relating to the centrifugal pump unit refer to TM 5-505.

Section II. DESCRIPTION AND DATA

3. Description

a. General information. The pump unit is a gasoline engine-driven, trailer-mounted, self-priming, centrifugal pump. The unit is designed for pumping gasolines, jet fuels, diesel fuels, light liquid petroleum fuels, and water. A right front, three-quarter view is shown in figure 1. A left rear, three-quarter view is shown in figure 2.

b. Engine. The pump is driven by a Wisconsin Model MVG4D air-cooled gasoline engine. The engine is of the four-cycle, air-cooled type. The four cylinders are designed in a 90-degree "V". The proper combustible mixture of air and gasoline is furnished by a float-type carburetor. The spark for ignition is furnished by a high-tension magneto driven by the timing gears at crankshaft speed. The magneto is provided with an impulse coupling, which is designed to produce a powerful spark and to automatically retard the timing of the spark to prevent the engine from kicking back.

(1) *Lubrication system.* A gear type pump supplies oil to four nozzles which direct oil streams against fins on the connecting rod caps. All bearings and moving parts inside the engine are lubricated by part of the oil which enters the connecting rod bearing through holes in the rods and by the balance of the oil which forms a spray or mist.

(2) *Cooling.* Cooling is accomplished by a flow of air circulated over the cylinders and heads of the engine by a combination fan-flywheel.

Note. Never operate the pump with any part of the engine shrouding removed, because this will retard the air cooling.

c. Pump. The pump is a conventional type centrifugal pump designed to deliver 350 gpm (275 TDH) at approximately 80 psi (pounds per square inch) discharge pressure.

4. Identification

The pump (fig. 3) has four identification plates: The Quartermaster Corps identification plate (A), engine identification plate (B), pump identification plate (C), magneto identification plate (D). All plates are conspicuously mounted for ready reference and contain serial numbers, model numbers, and manufacturer's name.

5. Tabulated Data

a. General.

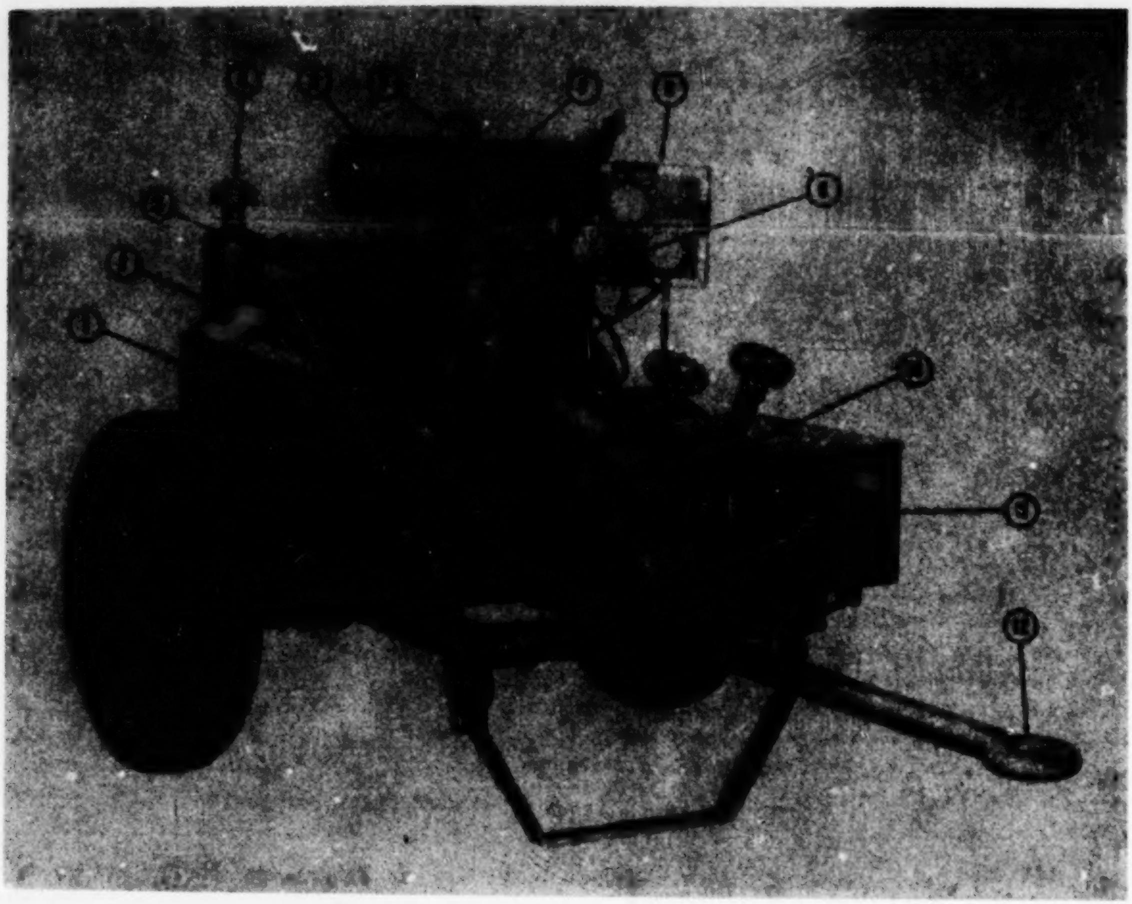
Length overall	102 in. (inches)
Length (tow bar retracted)	75 in.
Width	57 in.
Height	56 in.
Tire size	7.00 x 16
Tire pressure	25-30 psi

b. Engine.

Manufacturer	Wisconsin Motor Corporation
Type	Air-cooled
Model	MVG4D
Cylinder bore	3-7/16 in.
Stroke	4 in.
Piston displacement	148.5 cu. in. (cubic inches)
Horsepower:	
24 at	1400 rpm (revolutions per minute)
27 at	1600 rpm
30 at	1800 rpm
32.7 at	2000 rpm
34.5	2200 rpm
Carburetor:	
Manufacturer	Marvel-Schebler
Model No.	VH-69-A
Fuel pump:	
Manufacturer	Blackstone Manufacturing Co.
Model No.	GI-195-C
Governor:	
Manufacturer	Wisconsin
Model No.	T-84-H-1
Type	Centrifugal flyweight
Magneto:	
Manufacturer	Fairbanks-Morse
Model No.	FM-XZE4B7
Air cleaner:	
Manufacturer	Donaldson Co.
Model No.	A-A552

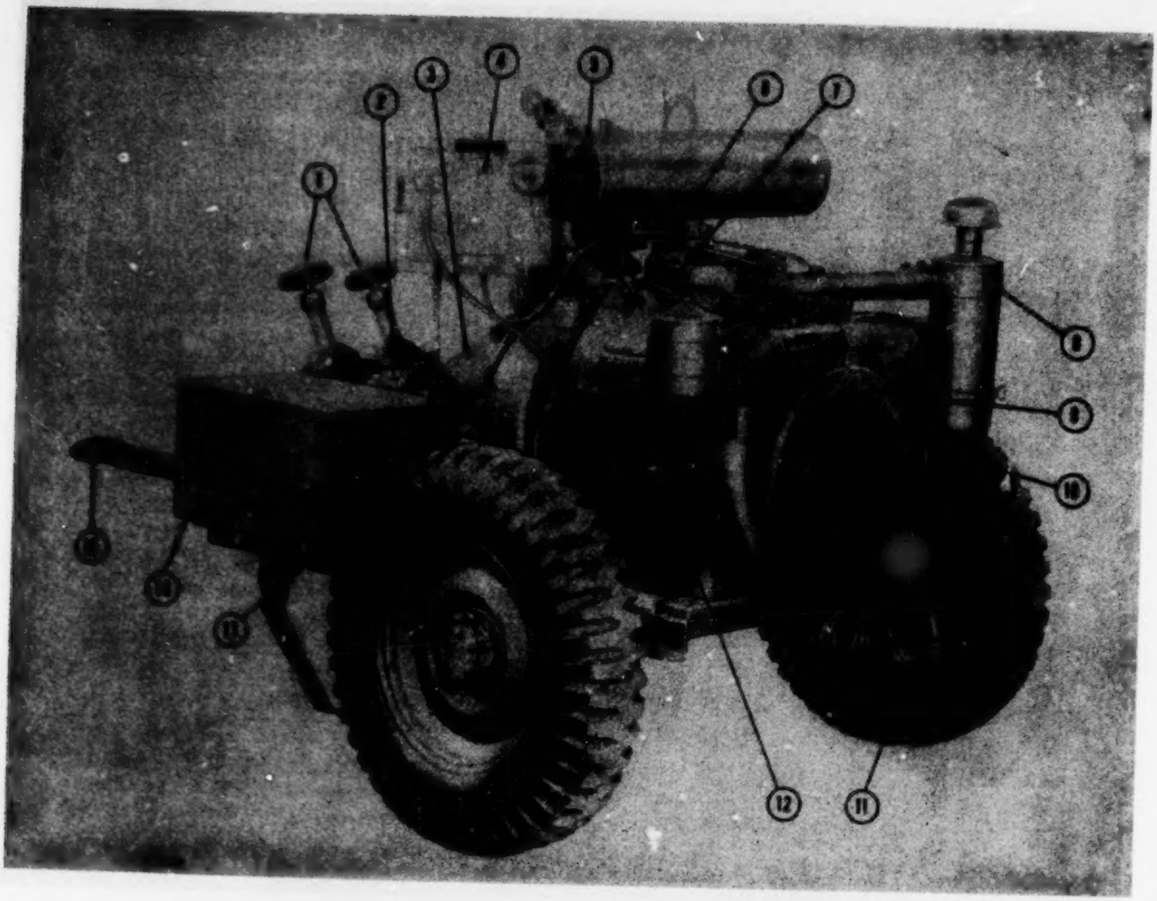
c. Pump.

Manufacturer	Gorman-Rupp
Model No.	O4A12-MVG4D
Type	Centrifugal
Number of stages	One
Volume flow	350 gpm
Total dynamic head	275
Suction size	4 in.
Discharge size	4 in.



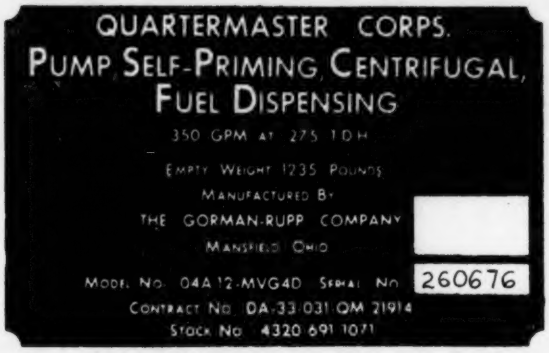
1 Fuel tank
2 Fuel tank cap
3 Right cylinder-head shroud
4 Air cleaner
5 Muffler
6 Lifting eye
7 Air venting valve
8 Control panel
9 Discharge pipe
10 Gate valve 4 in. (4 req'd)
11 Toolbox
12 Drawbar ring

Figure 1. Pumping unit assembly, right front, three-quarter view.

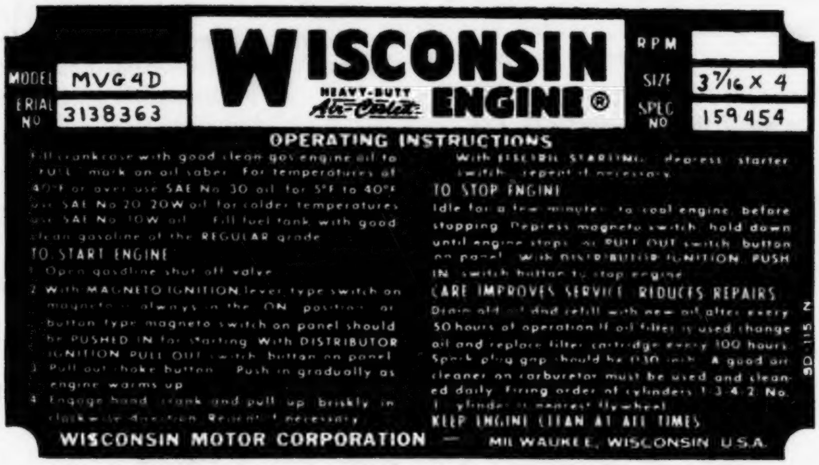


1 Gate valve, 4 in.
2 Suction manifold
3 Strainer
4 Control panel
5 Air eliminator
6 Spark plugs (4 req'd)
7 Ignition cable assembly
8 Air cleaner
9 Front engine panel
10 Oil filter
11 Pintle hook
12 Magneto
13 Pump assembly
14 Tool box
15 Draw bar ring

Figure 2. Pump assembly, left rear, three-quarter view.


QUARTERMASTER CORPS.
PUMP, SELF-PRIMING, CENTRIFUGAL,
FUEL DISPENSING
350 GPM AT 275 TDH
EMPTY WEIGHT 1235 POUNDS
MANUFACTURED BY
THE GORMAN-RUPP COMPANY
MANSFIELD OHIO
MODEL NO. 04A12-MVG4D SERIAL NO. 260676
CONTRACT NO. DA-33-031-QM-21914
STOCK NO. 4320-691-1071

A


MODEL MVG4D
SERIAL NO 3138363
WISCONSIN HEAVY-DUTY Air-Cooled ENGINE®
RPM
SIZE 3 7/16 X 4
SPEC NO 159454

OPERATING INSTRUCTIONS

Fill crankcase with good clean gas engine oil to "FULL" mark on oil saber. For temperatures of 40°F or over use SAE No 30 oil; for 5°F to 40°F use SAE No 20-20W oil; for colder temperatures use SAE No 10W oil. Fill fuel tank with good clean gasoline of the REGULAR grade.

TO START ENGINE
1. Open gasoline shut off valve.
2. With MAGNETO IGNITION lever type switch on magneto is always in the ON position, or button type magneto switch on panel should be PUSHED IN for starting. With DISTRIBUTOR IGNITION PULL OUT switch button on panel.
3. Pull out choke button. Push in gradually as engine warms up.
4. Engage hand crank and pull up briskly in clockwise direction. Repeat if necessary.

With ELECTRIC STARTING depress starter switch; repeat if necessary.

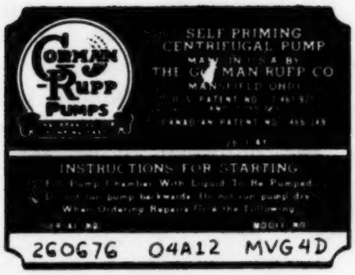
TO STOP ENGINE
Idle for a few minutes to cool engine before stopping. Depress magneto switch, hold down until engine stops, or PULL OUT switch button on panel. With DISTRIBUTOR IGNITION, PUSH IN switch button to stop engine.

CARE IMPROVES SERVICE, REDUCES REPAIRS
Drain old oil and refill with new oil after every 50 hours of operation. If oil filter is used, change oil and replace filter cartridge every 100 hours. Spark plug gap should be .030 inch. A good air cleaner on carburetor must be used and cleaned daily. Firing order of cylinders 1-3-4-2. No. 1 cylinder is nearest flywheel.
KEEP ENGINE CLEAN AT ALL TIMES

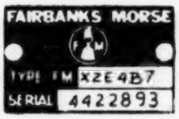
WISCONSIN MOTOR CORPORATION — MILWAUKEE, WISCONSIN U.S.A.

5D-115 N

B


GORMAN-RUPP PUMPS
SELF PRIMING
CENTRIFUGAL PUMP
MADE IN U.S.A. BY
THE GORMAN-RUPP CO
MANSFIELD OHIO
U.S. PATENT NO. [illegible]
CANADIAN PATENT NO. [illegible]
INSTRUCTIONS FOR STARTING
Fill Pump Chamber With Liquid To Be Pumped.
Do not run pump backwards. Do not run pump dry.
When Ordering Repairs Give the Following
SERIAL NO. MODEL NO.
260676 04A12 MVG4D

C


FAIRBANKS MORSE
FM
TYPE FM XZE4B7
SERIAL 4422893

D

A Quartermaster Corps **C** Pump
B Engine **D** Magneto

Figure 3. Identification plates.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

6. General

The pump unit is export boxed, processed and packaged according to level A. Prior to operating the pump, a careful inspection should be made to make sure that the condition of the unit has not changed during shipment.

7. Inspection and Installation

a. Check all bolts and nuts for tightness.

b. Inspect assembled pump for damaged and broken parts.

c. Check engine crankcase oil level. Add oil if necessary.

d. Fill fuel tank with gasoline if necessary.

e. Actuate hand primer lever about 20 to 30 strokes or until it moves easily.

f. Install grounding rod and attach groundin cable to rod and to pump frame.

g. Start the pump in accordance with procedure in paragraph 12 and conduct the following break-in procedures.

(1) Operate one hour at 1000 rpm.

(2) Operate one-half hour at 1500 rpm.

(3) Operate one-half hour at 2000 rpm.

(4) Unit should now be broken in for regular duty.

h. Locate the pump as close as possible to fuel supply source.

i. The pump should be level when intalled with the stand support secured in the down position.

Section II. CONTROLS AND INSTRUMENTS

8. General

This section decribes, locates, illustrates, and furnishes the operator or crew sufficient information about the various controls and instruments for the proper operation of the pump assembly. The operator should be thoroughly familiar with the location and function of every control and instrument before operating the pump.

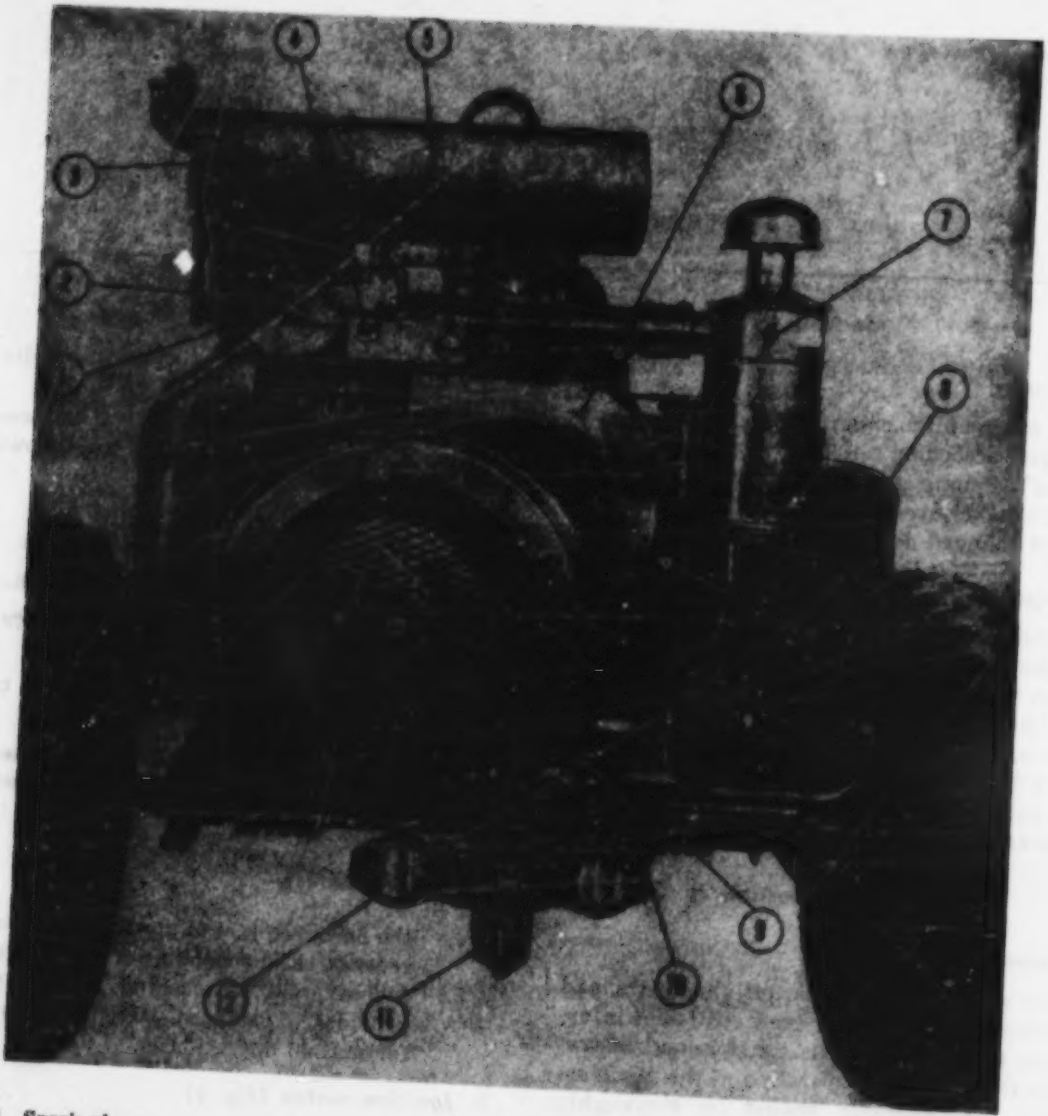
9. Engine Controls

a. *Choke control* (fig. 4).

- (1) *Location*. The choke control (5) is located on the engine front end panel (6).
- (2) *Purpose*. The choke provides a means of reducing the amount of air entering the carburetor. Pulling the choke out reduces the proportion of air in the fuel-air mixture; pushing it fully in provides a balanced fuel-air mixture for normal operation.

b. *Ignition switch* (fig. 4).

- (1) *Location*. The ignition switch (4) is located on the engine front end panel (6).
- (2) *Purpose*. The ignition switch controls the ignition circuit. When in the ON position it permits a high-tension current to be transmitted from the magneto to the spark plugs. When in the OFF position it shorts out the magneto coil and stops the engine.



1	Spark plug
2	Manifold assembly
3	Muffler
4	Ignition switch
5	Choke control
6	Engine front end panel
7	Air cleaner
8	Fuel tank
9	Ground rod holder
10	Frame
11	Pintle hook
12	Reflector

Figure 4. Engine front end panel.

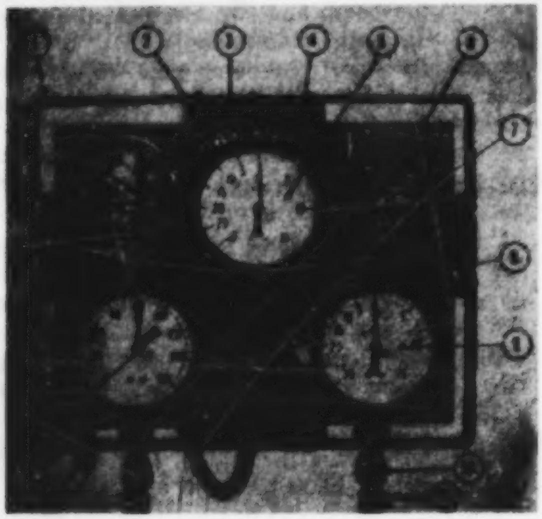
c. *Throttle control* (fig. 5).

(1) *Location.* The throttle control (12) is located near the engine instrument panel.

(2) *Purpose.* The throttle control provides a means of controlling the engine speed. Pushing the throttle fully in reduces engine speed to idling; pulling it fully out permits the engine to operate at governed speed.

d. *Vacuum gage* (fig. 5).

(1) *Location.* The engine vacuum gage (5) is located in the upper center of the control panel (4).



1	Frame
2	Shock mount
3	Gage identification plate
4	Control panel
5	Vacuum gage
6	Name plate
7	Engine oil pressure gage
8	Gage identification plate
9	Pump suction gage
10	Connector 1/4 in. NPT by 1/4 in.
11	Flex oil line
12	Throttle control
13	Pump pressure gage
14	Gage identification plate
15	Tachometer-hourmeter

Figure 5. Pump assembly instrument panel.

(2) *Purpose.* The engine vacuum gage is a measure of the engine horsepower output. The horsepower required to drive the pump varies with the weight of the liquid being pumped and the capacity or rate of pumping. For example, jet fuel having a specific gravity of .8 requires only eight-tenths as much horsepower at a given flow as does water having a specific gravity of 1.0. The engine vacuum gage works in such a way that the more the vacuum reading the less the horsepower. To prevent overloading of the engine, always set engine throttle so as to have at least five inches vacuum on engine vacuum gage regardless of liquid being pumped or the rate of pumping and regardless of speed of engine.

e. Oil pressure gage (fig. 5).

(1) *Location.* The oil-pressure gage (7) is located on the control panel in the upper right-hand corner.

(2) *Purpose.* The oil-pressure gage provides a means of determining the oil pressure within the lubricating system.

f. Tachometer-hourmeter (fig. 5).

(1) *Location.* The tachometer-hourmeter (15) is located on the control panel in the upper left corner.

(2) *Purpose.* The tachometer-hourmeter registers the rpm of the engine and maintains a running total of the engine operating hours.

10. Pump Controls

a. Check valve throttle.

(1) *Location.* The check valve throttle is located on the left-hand side of the check valve as you face the gage panel.

(2) *Purpose.* The check valve throttle adjusts to the opening and closing of the check valve. Normally the check valve should close automatically when the pumping operation is discontinued to retain enough fuel in the pump and suction hose for priming the pump in subsequent operations. The check valve throttle can be manually opened to drain the liquid back through the pump and the suction hoses when required.

b. Suction gage (fig. 5).

(1) *Location.* The suction gage (9) is located in the lower right-hand corner of the control panel.

(2) *Purpose.* The suction gage indicates the pump's suction on a dial graduated from –30 psi to +15 psi.

c. Pressure gage (fig. 5).

(1) *Location.* The pressure gage (13) is located in the lower left corner of the control panel.

(2) *Purpose.* The pressure gage measures the pressure of the pump operation

on a dial graduated from 0 psi to 160 psi.

d. Gate valves (fig. 1).

(1) *Location.* Two of the gate valves (10) are located on the suction manifold of the pump and two are located on the discharge manifold.

(2) *Purpose.* The pump gate valves are designed to control the flow of fuel in the system.

Section III. OPERATION UNDER USUAL CONDITIONS

11. General

a. The instructions in this section are published for the information and guidance of the personnel responsible for the operation of pump.

b. It is essential that the operator know how to perform every operation necessary to utilize the equipment fully. This section gives instructions on starting and stopping, operating details, and the steps necessary to move the equipment to a new location.

12. Starting

a. Starting precautions.

(1) Install grounding rod and cable by making a positive connection between the rod and the pump frame.

(2) Check the crankcase oil level and make sure that the engine and pump components are lubricated as instructed in the lubrication guide (fig. 8).

(3) Operate the fuel pump primer and pump fuel into the carburetor as required.

(4) Close the suction valve and fill the pump with the liquid to be pumped if the pump and suction manifold are not already filled.

(5) Open the air venting valve (7, fig. 1).

b. Starting.

(1) Pull the throttle halfway out and place the ignition switch in ON position.

(2) Choke as required by pulling the choke out and adjusting it after the engine starts and runs smoothly.

(3) Insert the crank and engage the crankshaft.

(4) With the crank in position, pull up against compression with a vigorous quarter-turn. Do not attempt to spin the engine with the crank. If the engine does not start on the first quarter-turn of the crank, re-engage and repeat the operation.

(5) Adjust the throttle so that the tachometer indicates 1000 rpm.

(6) Open the suction valves. Pump should pick up its prime in a few minutes. If the pump does not prime after five minutes, increase the engine speed to 1500 rpm for about five minutes until prime is achieved; then reduce speed to 1000 rpm.

(7) Close the discharge valves and then open each valve about three turns to reduce amount of liquid being pumped. This prevents overloading the pump at lowspeed.

(8) Slowly increase the speed as conditions allow.

Note. Maintain at least five inches of vacuum on the engine vacuum gage to prevent overloading the engine.

13. Stopping

a. Adjust the throttle to reduce engine speed to idling; allow the engine to idle from 3 to 5 minutes.

b. Push the ignition switch to the OFF position. Close the discharge manifold gate valves, then the suction manifold gate valve to retain the liquid in the pump and suction line. Push the ignition switch to the OFF position. If the liquid is permitted to run out of the suction line, it will be necessary to prime the pump when starting again.

14. Operating Details

a. Set the idling speed when the unit has been operated long enough to become warm. Adjust the throttle until the minimum steady idling speed is obtained. Screw the low-speed adjustment of the carburetor in or out until the engine runs steady and as fast as the throttle position will permit in accordance with paragraph 58*b*.

b. The horsepower required to drive the pump varies with the weight of the liquid being pumped and the capacity or rate of pumping. To prevent overloading, the engine throttle should be adjusted so as to have at least 5 inches vacuum on the engine vacuum gage regardless of liquid being pumped or the rate of pumping and regardless of speed of the engine.

c. A composite pump performance curve for the pump unit is shown in figures 6 and 7.

(1) Pump capacities are shown in gallons per minute. Pump discharge pressures are shown in pounds per square inch and in feet of head of the liquid pumped.

(2) These two sets of curves are for fuels of different specific gravities.

(3) Lines of constant brake horsepower represent the loading of the engine for various pumping conditions. They are characteristic of the Wisconsin MVG4 D engine and apply to both curves. This engine will give satisfactory service as long as the brake horsepower does not continuously exceed the maximum continuous performance shown on the curves.

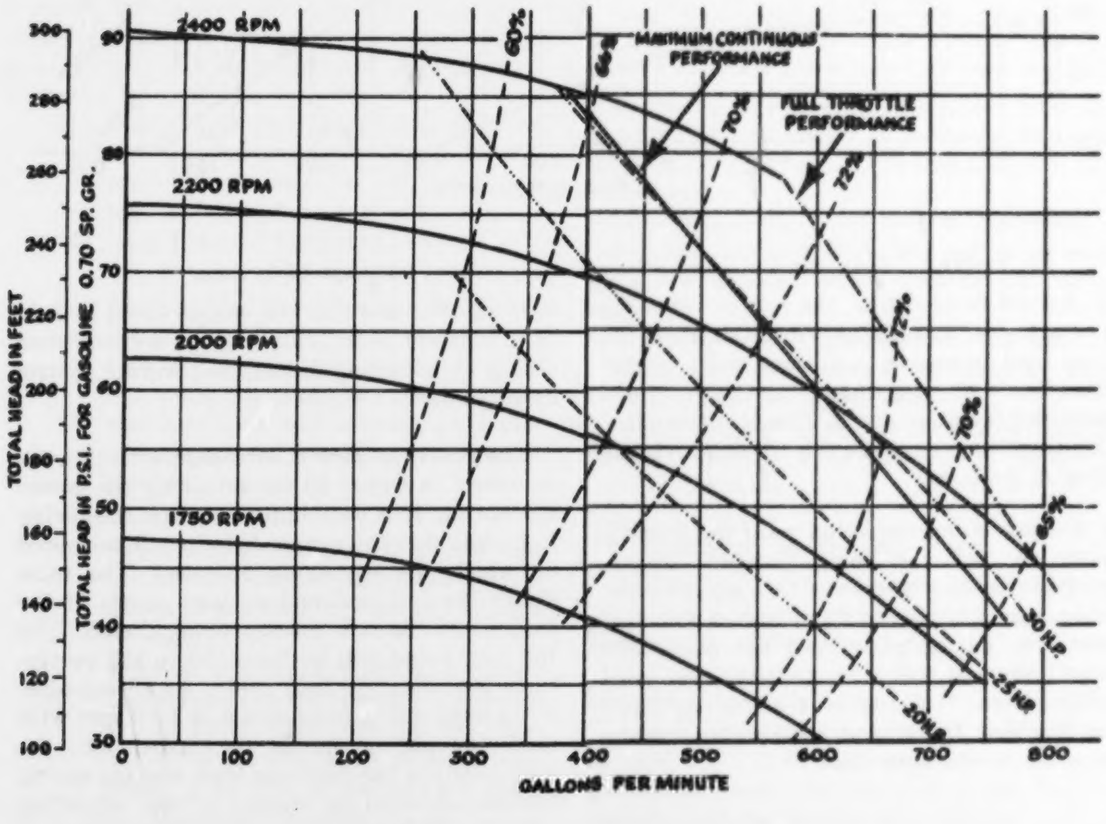


Figure 6. Performance of pump unit pumping gasoline @ 0.70 specific gravity.

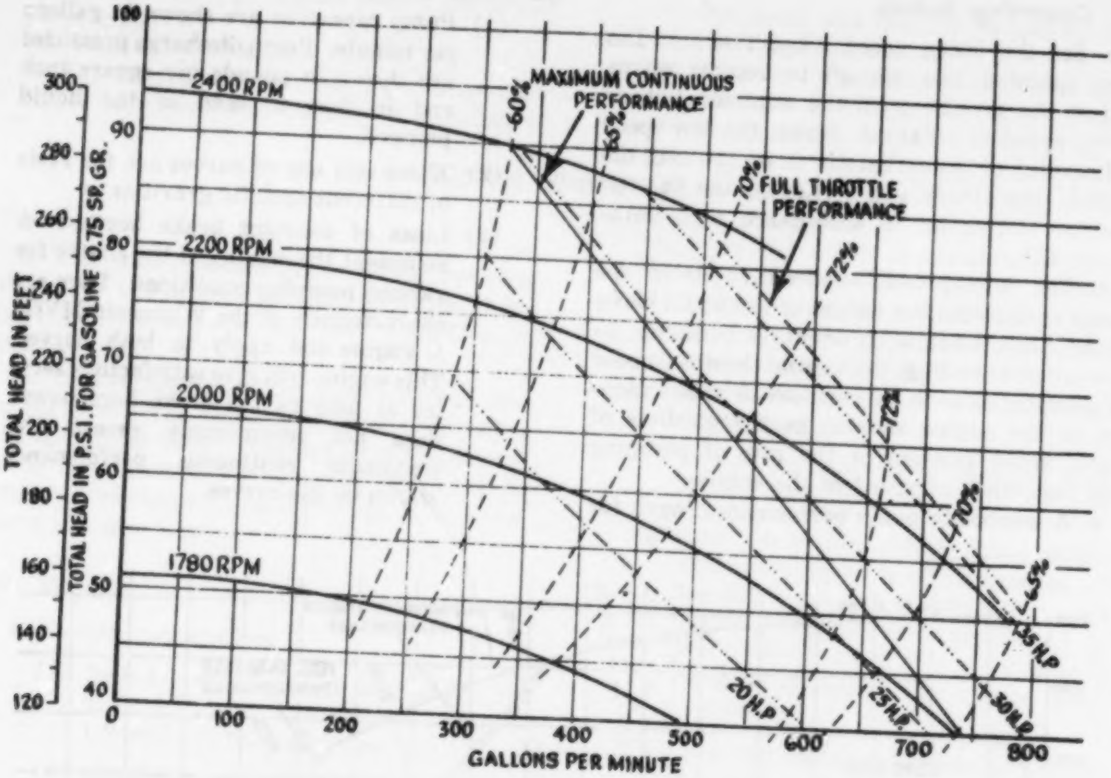


Figure 7. Performance of pump unit pumping gasoline @ 0.75 specific gravity.

d. As will be seen from the curves, when liquid of a higher specific gravity is pumped, the engine load increases, and care must be exercised that the maximum continuous brake horsepower is not exceeded. This is accomplished by throttling or reduction of the governor setting as necessary.

e. During pump operation with the specific gravity of the fuel being pumped known, the fuel being pumped in gallons per minute may be reasonably accurately obtained; the engine speed and the pump discharge pressures are noted and fuel flow read directly from the curve of pump performance. Further, the engine horsepower may be determined at the same time.

f. For various operations of the pump unit, i.e., transfer, dispensing, and receiving it is most desirable that the engine speed be held at a constant level. This may be accomplished simply by adjusting the engine governor control as follows:

The governor lever is furnished with 12 holes as shown in figure 13 for attaching the governor spring. It is very important that the spring is hooked into the proper hole to suit the speed at which the engine is operated. The table shows the full load and no load speeds of the engine and the hole corresponding thereto. The full load speed will be from 150 to 125 revolutions less than the load speed. As an example, if the engine is to be operated at 2000 rpm with load, the spring should be hooked into the eighth hole in the governor lever and the spring tension adjusted by means of the adjusting screw on the spring to run at 2125 rpm no load or approximately 2000 rpm under load.

15. Movement to a New Location

a. Open draincock in the bottom of the pump and drain the remaining fuel in the pump into a suitable container.

b. Remove the cover plate and clean out any residue or foreign material which may have accumulated.

c. After the pump has been stopped, close all the gate valves and remove the pump strainer.

(1) Clean the strainer and the suction manifold.

(2) Seat the strainer basket in the circular groove of the strainer body so that the lid of the strainer body can be installed without causing any stress in the lid when the lid is tightened.

d. Cover the suction and discharge openings with appropriate dust covers issued with the equipment.

e. Remove all grease, mud, and dirt from the exterior of the pump, engine, and the trailer assembly.

f. Disconnect the grounding wire and retrieve the grounding rod.

g. If the pump is being towed, secure the front stand support in the up position after the tow bar is secured to the towing vehicle.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

16. Operation in Extreme Cold

a. General. Special precautions are necessary to obtain satisfactory performance of the equipment in subzero temperatures. The precautions given below will help prevent malfunctioning and assure continuous operation.

(1) Clear the area surrounding the fuel tank filler cap and the lip of the dispensing equipment of all snow, ice, and moisture before filling tank.

(2) Keep filler cap tightened to keep snow, ice, rain, or dirt out of the tank.

(3) Thoroughly clean container before using for fuel storage.

(4) If possible, keep fuel tank full when operating the pump in extremely cold weather. This will prevent an excessive amount of water condensation in the fuel lines.

b. Engine ignition system.

(1) Replace magneto breaker points that are pitted or burned. Clean the breaker cam and lubricate it with a few drops of engine oil.

(2) Remove the spark plugs and reduce the-normal gap between the electrodes from 0.030 to 0.025 inch. Pretest plugs for defective insulators or electrodes. Keep plugs free of ice and moisture.

c. Engine air cleaner. Remove the air cleaner and wash thoroughly with cleaning solvent; dry thoroughly. Reassemble and fill the air cleaner cup to the level mark with oil specified in the lubrication guide. (fig. 8).

Note. When servicing the air filter, also check to see that the hose clamps to the carburetor are tight to make all connections as nearly air tight as possible.

d. Shelter. Whenever possible, locate the unit so as to provide shelter from the elements, using a building, snowdrift, canvas, or hill as a windbreak.

e. Starting. Start the unit as instructed in paragraph 12*b* and allow the engine to warm up a few minutes before opening the suction valves.

(1) Close the discharge valves and then open each valve three turns to reduce liquid being pumped.

(2) Adjust the engine throttle so that the vacuum gage indicates' 5 inches of vacuum.

17. Operation in Extreme Heat

a. General. Locate the pump in a well-ventilated area that will allow a maximum amount of cool air for cooling the engine.

b. Cooling system protection. Be sure that all shrouding is installed and in good condition. Keep cylinder head and cylinder fins free of any oil and dirt. If dirt accumulates, remove the shrouding, clean the fins and vanes, and reinstall the shrouds.

c. Special lubrication instructions. Select the correct lubricants in accordance with the expected air temperatures as indicated in the lubrication guide (fig. 8).

d. Fuel system protection. Fill the fuel tank at the end of each day's operation to prevent an accumulation of vapor in the fuel tank.

18. Operation Under Sandy or Dusty Conditions

a. General. Protect the unit from dust or as much as possible. Cleanness of the pump is important for proper cooling and operation.

b. Special lubrication instructions. Take special care to service the air cleaner as often as necessary. When adding oil, remove any dirt or sand from around the filler neck. Keep the crankcase breather cap clean. Lubricate in accordance with the current lubrication guide (fig. 8). Refer to paragraph 29*b*.

c. Protecting stores of oil and fuel. Keep stores of oil and fuel tightly closed to protect them from dust or sand. If possible, store the supplies in a shed or storage room.

19. Operation in Salt Water Area

a. General. When the pump is operated near bodies of salt water, the salt air will quickly attack unpainted surfaces. Remove any rust formations immediately and cover the exposed surfaces with paint. Lightly coat any machined surfaces with oil.

b. Special precautions. To prevent rusting of cylinders, pistons, rings, and valves, remove the pipe plug from the intake manifold, or diconnect the air cleaner hose and introduce about one-fourth pint of rust preventative oil to the warmed-up running engine. A bluish smoke will indicate that enough oil was added. Check all electrical contacts daily; replace corroded parts.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. SPECIAL ORGANIZATIONAL TOOLS AND EQUIPMENT

20. General

There are no special tools required for the maintenance of this pump.

21. On-Equipment Tools and Parts

See Basic Issue Items List, Appendix III.

Section II. LUBRICATION AND PAINTING

22. General Lubrication Information

The lubrication guide as shown in figure 8 prescribes first and second echelon lubrication maintenance for the pump unit.

23. Detailed Lubrication Information

a. Care of lubrication equipment.

(1) Keep lubrication equipment in a place where it will be safe from damage and free from the intrusion of dust and dirt. Clean the equipment both before and after use.

(2) When filling a grease gun, make sure that the cylinder is completely filled before the head is installed. This will prevent the formation of air pockets which otherwise would keep the grease from penetrating to the fittings. The presence of air pockets can usually be detected by springs or by uncertain action of the grease-gun handle. In cold weather, the grease gun can be filled easily and properly if both the gun and lubricant are first warmed. Take care, however, not to overheat the gun, as this will warp the metal and damage leather seals.

(3) Do not attempt to apply lubricant with a defective grease gun. If working parts show signs of failure, requisition a new gun.

(4) After the grease gun has been filled and assembled, operate the handle several times to force air from the cylinder and dirty grease from the hose couplings.

b. Cleaning. Wipe all lubricators, fittings, and surfaces surrounding the points of application to remove dirt and old lubricants before applying the lubricant. Use an approved cleaning solvent to clean or wash the lubricators and nearby surfaces. Do not use gasoline for this purpose. After washing, dry lubricators thoroughly before applying lubricant.

c. Points of application. The points of application are identified in figure 8.

d. Lubrication notes. The following detailed instructions supplement the notes in the current lubrication guide for some of the more complex lubrication operations.

(1) *Engine crankcase.* Check the engine crankcase oil level daily, and add oil as necessary. Drain the oil while the engine is still warm by removing the drain plug located in the bottom left side of the crankcase. Install the drain plug, remove the breather cap from the fill pipe, and refill the crankcase with oil in accordance with the lubrication guide. Check the oil level with the bayonet gage. Be careful not to fill the crankcase over the full mark on the bayonet gage.

LUBRICATION

ORDER

LO 5-4320-218-15

PUMP, CENTRIFUGAL: PETROLEUM; GASOLINE DRIVEN, TRAILER MTD; 4 IN. 350 GPM, 275 FT HEAD (GORMAN-RUPP MODEL 04A12-MVG4D) W/WISCONSIN ENGINE MODEL MVG4D

REFERENCE: SM 10-1-C4-1

Intervals are based on normal operation. Reduce to compensate for abnormal operations and severe conditions. During inactive periods sufficient lubrication must be performed for adequate preservation.

Clean fittings before lubricating.

Relubricate after washing or fording.

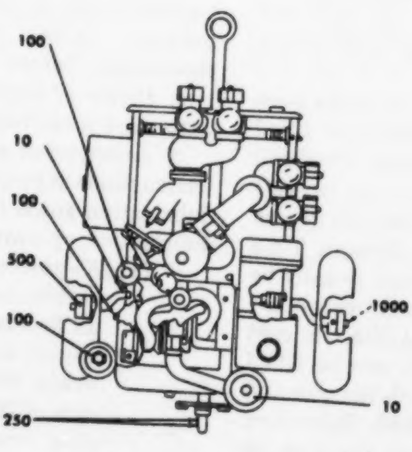
Clean parts with SOLVENT, dry-cleaning, or with OIL, fuel, Diesel. Dry before lubricating.

Drain crankcase only when hot after operation; replenish and check level when cool.

Lubricate points indicated by dotted arrow shafts on both sides of the equipment.

LUBRICANT • INTERVAL

INTERVAL • LUBRICANT



① Crankcase Fill and Breather Cap (Clean and re-oil) (See key) OE 100

② Crankcase Oil Level Gage (Check level) 10

③ Crankcase Drain Plug (Drain and refill) 100

④ Magneto Cam Wick (Sparingly) OE 500

⑤ Oil Filter (Disassemble, clean housing, renew element and reassemble) (See note 2.) 100

⑥ Pintle Hook (2 fittings) GAA 250

1000 GAA Wheel Bearing (Remove wheel, clean, inspect and lubricate bearings and reassemble) ⑦

10 OE Air Cleaner (Refill oil reservoir to level mark, every 50 hours disassemble entire unit, clean, re-oil and reassemble) (See key) ⑧

CONTINUED ON FOLLOWING PAGE

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1 LO 5-4320-218-15—front.

Figure 8. Lubrication order.

CONTINUED FROM
PRECEDING PAGE

– KEY –

LUBRICANTS	CAPACITY	EXPECTED TEMPERATURES			INTERVALS
		Above +32°F	+40°F to 10°F	0°F to 65°F	
OE -OIL, Engine, Heavy Duty		OE 30 or 9250	OE 10 or 9110	OES	Intervals given are in hours of normal operation.
Crankcase	5 qt				
Air Cleaner	3/4 qt				
Oil Can Points					
OES -OIL, Engine, Subzero					
GAA -GREASE, Automotive and Artillery		All temperatures.			

NOTES:

1. FOR OPERATION OF EQUIPMENT IN PROTRACTED COLD TEMPERATURES BELOW −10 F°. Remove lubricants prescribed in the key for temperatures above −10°F. Clean parts with SOLVENT, dry-cleaning. Relubricate with lubricants specified in the key for temperatures below −10°F.

2. OIL FILTERS. After installing new filter elements, fill crankcase, operate engine 5 minutes, check housings for leaks, check crankcase oil level and bring to full mark.

3. OIL CAN POINTS. Every 50 hours clean and lightly coat the governor and carburetor linkage, axle mounts, all clevis pins and hinges with OE.

Copy of this Lubrication Order will remain with the equipment at all times; instructions contained herein are mandatory.

BY ORDER OF WILBER M. BRUCKER,
SECRETARY OF THE ARMY:

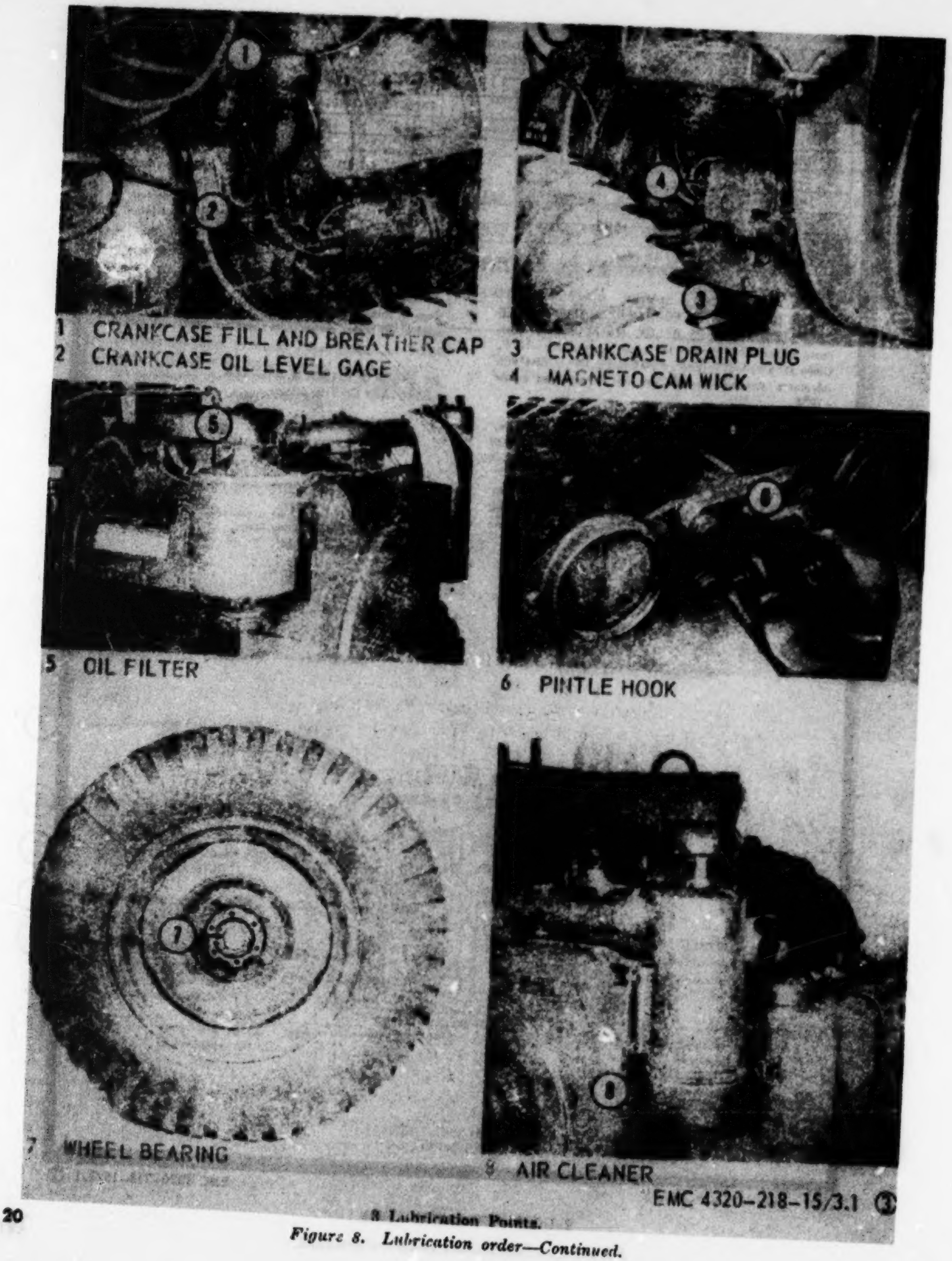
G. H. DECKER,
General, United States Army,
Chief of Staff.

OFFICIAL:
R. V. LEE,
Major General, United States Army,
The Adjutant General.

EMC 4320-218-15/3.1 ②

2 LO 5-4320-218-15—back.

Figure 8. Lubrication order—Continued.


1 CRANKCASE FILL AND BREATHER CAP
2 CRANKCASE OIL LEVEL GAGE
3 CRANKCASE DRAIN PLUG
4 MAGNETO CAM WICK
5 OIL FILTER
6 PINTLE HOOK
7 WHEEL BEARING
8 AIR CLEANER
EMC 4320-218-15/3.1 ③

8 Lubrication Points.

Figure 8. Lubrication order—Continued.

(2) *Air cleaner.* Check the oil level and sediment content in the air-cleaner cup daily. Clean and add oil as required. At weekly intervals (50 hours of operation), remove the air-cleaner bowl, drain, and wash it with solvent. Refill with oil to the proper level. Wash the air filter body in solvent. Add oil to the filter and element; allow excess oil to drain off.

(3) *Oil filter.* Change the filter element after every other oil change. If operating conditions are extremely dusty, replace element after every oil change.

(4) *Governor and carburetor linkage.* Lubricate in accordance with the lubrication order (fig. 8).

24. Lubrication Under Unusual Conditions

a. General. Adjust service intervals specified in the lubrication guide to compensate for abnormal operation and extreme conditions, such as high or low temperatures, prolonged periods of high-speed operation, continued operation in sand or dust, immersion in water, or exposure to moisture, any one of which may quickly destroy the protective qualitites of the lubricant. Intervals may be extended during inactive periods. See paragraphs 16 through 19 for operations under unusual conditions.

b. Changing grades of lubricants. In the key to the lubrication guide, lubricants are prescribed in accordance with three temperature ranges: above +32° F; from +32° to -10°F.; and below -10° F. Sluggish starting is an indication of lubricant-thickening, and is the signal to change grades prescribed for the next lower temperature range. Ordinarily, it will be necessary to change grades of lubricants only when air temperatures are consistently in the next higher or lower range.

25. Painting

a. The pump assembly should be repainted whenever the existing paint shows signs of wearing off, cracking, peeling, or deteriorating in any way.

b. Before starting to paint, make sure that all machined surfaces, lubrication fittings, breather caps and vents, identification plates, wires, and other electrical parts are protected with masking tape. Make sure that paint does not get on exposed threads of carburetor and governor control linkage.

c. Paint all exposed surfaces of chassis, hood, fuel tank, instrument panel, and external controls. Paint olive drab No. 23 in acordance with specifications MIL–T–704.

Section III. PREVENTIVE MAINTENANCE SERVICE

26. General

The operator or crew and the organizational maintenance personnel must perform their preventive maintenance service regularly, to make sure that the pump operates effectively and to lessen the chance of mechanical failure. See Maintenance Allocation Chart, Appendix II, for authorized echelons of maintenance.

27. Operator or Crew Maintenance

a. Inspection. Inspections must be made before operation, during operation, at halt, and after operation, as described in this section. All inspections of assemblies, subassemblies, or parts must include any supporting members or connections and must determine whether the unit is in good condition, correctly assembled, and secure, or excessively worn. Any mechanical or electrical condition which may result in further damage to the unit must be corrected before equipment is operated.

b. Reporting deficiencies. The operator will report all deficiencies on the prescribed form.

c. Before-operation service. Perform the following services to determine if the condition of the pump has changed since it was last operated, and to make sure that the equipment is ready for operation. Any deficiencies must be corrected or reported to the proper authoity before the unit is put into operation.

(1) *Fuel.* Check fuel supply. See that fuel tank is full. Check fuel strainer; clean and drain if necessary.

(2) *Oil.* Check oil level in engine crankcase. See that oil is at proper level. Check reserve supply of lubricants and replenish if necessary.

(3) *Tampering and damage.* Inspect for tampering or damage that may have occurred since the unit was last operated. Check the rear of the control panel to make sure that there are no loose connections on any of the components. Be sure all connections are tight and that each component on the control panel is in good condition.

(4) *Location and alinement.* Locate the pump as close as possible to the source of supply. Each time the pump is relocated see that the unit is on solid footing and approximately level. Block the wheels securely and carefully anchor the support stand. Make sure the unit is properly grounded.

(5) *Fuel line connections.* Check all the suction and discharge lines. Make sure the lines are independently supported near the pump, so that no strain will be transmitted to the pump when the connections are made. Arrange the lines with as few bends as possible. Make required bends with a long radius whenever possible. Be sure each connection is properly fitted and fastened.

(6) *Filling pump with liquid.* Close the suction valves and fill the pump with the liquid to be pumped. To run the pump dry may cause severe damage to the pump seal.

(7) *Pump strainer.* Clean the pump strainer if necessary.

(8) *Visual inspection.* Make a visual inspection of the entire unit for cracks, breaks, or loose or missing bolts and nuts. Make sure that all engine accessories are properly mounted, adjusted, in good operating condition, and that all connections are secure.

d. During-operation services. The operator of the pump is responsible for correcting or reporting unusual sounds or odors, deficiencies in performance, or other signs of abnormal operation.

(1) *Unusual operation and noises.* Check for any abnormal operation, such as engine overheating or running at below governed speed, failure of the pump to deliver full volume or to respond to controls. Stop operation immediately if any unusual noise is noticed. Examine the pump for signs of undue heating.

(2) *Gage readings.* Check all gage readings frequently, watching particularly to see that there is no unusual drop in engine oil pressure, and that the engine vacuum gage indicates at least 5 inches vacuum regardless of the liquid being pumped or the rate of pumping and regardless of speed of the engine.

(3) *Leaks.* Check the entire unit for leaks, paying particular attention to the pump seal. If a leak is noticed it must be corrected or reported to the proper authority. Look under the trailer for signs of leaks and check the engine fuel lines and connections. Stop operation in case of a bad leak, and make the necessary correction and report to the proper authority. If leaks are found which do not seriously affect the operation of the equipment, and if continued operation will not cause damage to the pump or engine, make note of the deficiency and see that it is corrected as soon as possible. Examine the suction and discharge hose assemblies and check valve connections for leaks.

e. At-halt services. During halts, even for short periods, the operator should make a general check of the equipment and should correct and report any deficiency noticed, in addition to performing the following specific duties:

(1) Shutdown precautions.

(*a*) Adjust the throttle and reduce engine rpm to idling speed.

(*b*) Allow engine to idle for a minimum of 3 to 5 minutes before stopping to prevent warping of valves and to allow engine to cool evenly.

Turn off the ignition switch and stop the engine.

(2) *Fuel and oil.* Check fuel and oil levels. Add fuel and oil as necessary.

(3) Check the entire unit for leaks, paying particular attention to the pump seal. Report all deficiencies. Do not start operation again if there is a bad leak that cannot be corrected immediately. Examine the suction hose assembly and check valve connections for leaks.

(4) *Visual inspection.* Check the entire pump assembly visually, checking for broken or damaged parts, for loose or missing mountings and assembly nuts and bolts, and for signs of deterioration of hose assemblies.

f. After-operation services. To insure that the equipment is ready to operate at any time, the following services must be performed by the operator or crew immediately after any operating period of 8 hours or less. All deficiencies should be corrected and reported to the proper authority.

(1) *Fuel.* Check fuel supply in tank. Refill if necessary.

(2) *Engine crankcase oil.* Check oil level in crankcase. Refill to indicated mark on oil gage. See lubrication order (fig. 8).

(3) *Clean equipment.* With an approved cleaning solvent, remove all dirt and grease from the engine, housing parts, frame, and towing tongue. Remove all dirt and mud from the wheels, wheel hubs, axle, and springs, especially if freezing temperatures prevail.

(4) *Air cleaner.* Remove the bowl from the air cleaner and fill with the same grade of lubricant as used in the crankcase (see par. 29*b*).

(5) *Pump strainer.* Examine the pump strainer in the suction manifold and clean it if necessary.

(6) *Check valve.* Examine the operation of the check valve and be sure that it can be adjusted to close automatically when the pumping operation is discontinued.

(7) *Visual inspection.* Make a complete visual inspection of the pumping unit. Check for any missing bolts and nuts. Examine the engine air shrouds for dents and dirt which would restrict the normal flow of air. See that the tires are filled with air to a pressure of 45 psi, and are in good condition. Correct any deficiencies or report them to the proper authority.

28. Maintenance and Safety Precautions

a. Report and correct any mechanical deficiencies that may result in damage to the equipment if operation is continued.

b. Always stop the engine before making repairs or adjustments on any part of the pump.

c. After starting the engine, allow it to warm up at 1000 rpm and then increase speed to 1500 rpm for a few minutes.

d. Make sure that fuel and oil containers are clean.

e. Always provide a metallic contact between container and tank when adding gasoline.

f. Always run engine at idling speed for a few minutes before stopping.

g. Do not start pump until the suction valves have been closed and the pump filled with the liquid that is to be pumped.

h. Stop the pump immediately if unusual noises or odors are noticed. Do not continue operations until causes have been discovered and corrected.

29. Organizational Maintenance

a. Preventive maintenance is performed by organizational maintenance personnel at quarterly intervals. The quarterly interval is equivalent to 3 calendar months or 250 hours of operation, whichever occurs first.

b. The preventive maintenance services to be performed at these regular intervals are listed and described below.

Technical inspection	
	GENERAL
X	*Before-operation services.* Check and perform before-operation services detailed in paragraph 27*c*.
X	*Lubrication.* Inspect entire unit for missing or damaged lubrication fittings, and for indications of insufficient lubrication.
--	Replace missing or damaged fittings. Lubricate as specified in the lubrication order (fig. 8).
X	*Equipment.* Inspect condition of all equipment assigned to the pump.
--	See that all equipment is clean, serviceable, and properly stowed or mounted. Be sure toolbox can be fastened properly.
X	*Publications.* See that this technical manual and pumping charts are on or with equipment and are in serviceable condition.
X	*Appearance.* Inspect the general appearance of the pump, paying special attention to cleanness, legibility of identification markings, and condition of paint (par. 25).
--	See that all deficiencies are corrected, or report those uncorrected to proper authority.
	ENGINE AND ACCESSORIES
X	Cylinder heads, manifolds, and gaskets. Inspect cylinder heads, manifolds, and exhaust pipe for cracks, breaks, leaks, loose or missing mounting bolts and nuts, and defective gaskets.
	Tighten or replace loose or missing mounting bolts and nuts. Replace any defective gaskets. At the first quarterly servicing of new or reconditioned engines, check all cylinder-head bolts for tightness (par. 101*c*(2)).
X	*Valve mechanism.* (3d echelon). Check valve-tappet adjustments if noise or loss of power is noticed. Correct valve clearance is 0.11 to 0.13 for each valve when cold. Inspect mechanism for indications of weak or broken springs (par. 102).
	Adjust valve-tappet clearance if necessary (par. 102*b*). Be sure valve-cover gasket is in good condition and that the cover fits securely. Report a broken or defective spring to proper authority.
X	*Compression test.* (2d echelon) Start the pump and let it run until it reaches operating temperature. Remove spark plugs and insert a compression gage into the spark plug hole. Test each cylinder and record the readings. If gage readings vary more than 10 pounds, add 1 fluid ounce of crankcase oil to cylinders with low readings and retest.
	If compression was not restored by adding oil, check cylinder head bolts for tightness. Tighten any loose bolts, and retest. If low compression persists, the trouble lies with the cylinder-head gasket, valves, or piston rings. Replace a faulty head gasket and repair the valves if necessary. Report worn piston rings to proper authority.
X	*Crankcase.* Check crankcase for leaks, damage, or dents. Check oil filler and breather cap for cleanness.
	Clean a dirty oil filler and breather cap. Add oil to crankcase as necessary (see par. 24). Report a damaged crankcase to proper authority.
X	*Oil filter.* With the engine running, check the lines leading to oil filter for kinks, leaks, or other damage. Check body of oil filter for cracks and check to see that there is no leakage around the filter cover.
	Replace a damaged oil filter or any damaged lines. Correct any deficiencies noticed. Service the filter as instructed in the lubrication guide (fig. 8).
X	Engine air shroud. Check vanes of flywheel for cracks or breaks. Check air shroud for insecure mounting, bends, or cracks.
	Report a defective flywheel to proper authority. Correct any other deficiencies noticed (par. 71).
X	Governor and linkage. Inspect governor and linkage to see that they are secure and in good condition. Check linkage connections to see that they are not worn, do not bind and are properly adjusted and lubricated. Check governor operation under varying load conditions for surging or other improper operation. After testing, adjust governor spring tension to give an engine speed of 1800 rpm (par. 14).
	See that governor housing and linkage are in good condition and securely mounted. Report all deficiencies noticed.

Technical Inspection	ENGINE FUEL SYSTEM
X	*Fuel pump and housing.* Inspect fuel pump and connections for leaks. Check for loose mounting bolts. Inspect sediment bowl for contents other than fuel.
--	Tighten any loose screws and connections. Repair all leaks. Replace a defective pump. Clean sediment bowl and screen if necessary (par. 53*c*).
X	*Strainer.* With the engine running, check fuel filter, lines, and connections for leaks. Check for any indication of low fuel pressure such as loss of power, hard starting, or misfiring on various cylinders. Low fuel pressure indicates that strainer is dirty and requires cleaning or replacement (par. 53*c*).
--	After servicing strainer, check it for leaks while the engine is running. Replace gasket if it is worn or damaged.
X	*Air cleaner.* Inspect air cleaner for loose connections. Check condition of filtering element. Check condition and level of oil in filter bowl. Remove accumulated sediment.
	Service air cleaner as specified in the lubrication order (fig. 8). After reassembling, make sure that all connections are tight, and that there are no air leaks between air cleaner and carburetor.
X	Fuel tank, cap, and gaskets. Inspect fuel tank for insecure mounting brackets and bands, leaks, dirty or damaged filler cap or strainer. Check for dirt in tank.
--	Tighten all loose mounting bolts and nuts. Report any leaks to proper authority. Clean the filler cap. Replace leaky or damaged gasket or cap.
X	*Fuel lines.* Check fuel lines for leaks, loose connections, and damage.
	Repair or replace defective fuel lines. Tighten loose connections. Report all uncorrected deficiencies to proper authority.
	ENGINE ELECTRICAL SYSTEM
X	Spark plugs. Inspect installed spark plugs for dirty or cracked insulators and leakage past gasket. See that spark-plug wires from magneto are in good condition and are properly connected to plugs (par. 67).
	Clean oil and dirt from insulators. Replace defective spark plugs.
X	Remove spark plugs and inspect for worn or damaged gaskets. Check spark plug gaps which should be 0.030 inch.
	Clean spark plugs and adjust gap to 0.030 inch if necessary. To adjust gap, bend outer electrode only. Replace defective plugs (par. 68).
X	*Magneto.* Examine magneto for loose mounting bolts and wiring connections. Remove distributor cap from magneto housing and clean. Remove any corrosion from distributor rotor, rotor face, or its electrodes. Check free movement of brush and spring in socket for contact with rotor. Dry each part thoroughly before reassembling. Do not use abrasive to clean plate, rotor, or breaker cam.
	Clean rotor and distributor compartment. Lubricate cam-wiper felt with a few small drops of oil, following the lubrication order (fig. 8). Adjust breaker contact points by moving the plate until the opening is 0.015 inch (par. 66). Replace cam-wiper felt whenever it is necessary to replace the breaker contacts. Do not lubricate any oil-impregnated parts.
X	*Wiring, switches.* Inspect wiring for oil-soaked, cracked, or frayed insulation, broken wires, and loose or corroded connections. Check operation of ignition switch.
	Replace the ignition switch (par. 69) if it is damaged or defective. Replace wires that are missing. Tighten all connections to insure proper contacts.
	CONTROL SYSTEM
X	*Tachometer-Hourmeter.* Inspect the tachometer-hourmeter for secure mounting. Look for cracked or broken glass and for loose connections.
	Tighten or replace loose or missing mounting components. Replace the tachometer-hourmeter if it is damaged or defective. Lubricate tachometer cable (fig. 8).
X	*Gages.* See that all the gages operate properly and are securely mounted and that all connections are tight. Check each gage for cracked or broken glass and for loose connections.
	Tighten or replace loose or missing mounting components. Replace any gage that is damaged or defective (par. 131).
	Check valve. Inspect the spring, shaft, and all other components of the check valve assembly for proper operation and mounting security. See that the spring bracket, the weight arm, and the attaching parts are properly adjusted, in good condition, and not bent or distorted.

Technical inspection	
	Replace any missing or damaged parts. Tighten any loose components (par. 127).
	FRAMES AND WHEELS
	Tires. See that both valve stems are in good condition and correctly positioned, and that valve caps are present and installed securely. Do not tighten with pliers. Examine both tires for cuts, bruises, breaks, and blisters, and for any injuries extending into the cord body. Also look for signs of smooth wear in center of tread, irregular or one-sided wear, and flat spots, cupping, or feather edges.
	Tighten all wheel-rim flange or lug nuts securely. Replace tires that are worn beyond serviceable limits.
X	*Pintle-hook.* Inspect the pintle hook and support stand for insecure mounting and bent or broken parts.
	Tighten mounting if insecure. Repair or replace all damaged or missing parts.
X	*Wheels.* Check for loose or missing mounting bolts and leaking grease seals. Check wheel bearings for proper adjustment. Inspect rims for damage. Check for missing, loose, or broken mounting components.
X	Repack wheel bearings in accordance with lubrication order (fig. 8).
	Tighten loose wheel-mounting bolts. Replace leaking grease seals. Adjust wheel bearings if necessary (par. 74).
X	*Frame.* Inspect frame for bent members, breaks, and cracks, and poor alinement. Check for loose or missing bolts and nuts.
	Replace all missing bolts; tighten loose cap screws and nuts. Make sure that all other deficiencies are reported to proper authority.
	PUMP
X	Pump discharge housing. Inspect the pump discharge housing for cracks and breaks. See that all mounting and assembly bolts are in place and secure. See that the air venting valve is clean and in good condition. Examine the check valve linkage. Check the flange gaskets for damage.
	Tighten or replace any damaged parts. Replace any gaskets that are damaged (par. 135).
X	*Pump volute.* Inspect the pump volute for cracks and damage. Check for leaks at the impeller shaft seal. See that all mounting and assembly bolts are in place and secure.
	Tighten or replace any loose, missing, or broken mounting components.
X	*Pump strainer.* Inspect the wire mesh basket strainer element for torn wires and for pieces of foreign matter wedged in the wires.
	Remove the strainer and clean thoroughly with a stiff brush. Be sure that the strainer screen is installed so that it is properly seated in the circular groove of the body to allow the cover to be tightened without strain.
X	Air eliminator assembly. Remove the seven screws that secure the cover in place and lift out the float and the valve assembly. Examine the float for cracks, breaks, and surface irregularities. Inspect the valve and make sure that the valve fits firmly in the seat.
X	Replace the float if it does not form a tight seal with the air eliminator gasket. Replace the valve, the valve lever, or the valve lever clip if they are damaged (par. 132).

Section IV. TROUBLESHOOTING

30. Use of Troubleshooting Section

This section povides information useful in diagnosing and correcting unsatisfactory operation or failure of the pump or any of its components. Each trouble symptom stated is followed by a list of probable causes of the trouble. The possible remedy recommended is described the probable cause.

31. Engine Fails to Start

Probable cause	*Possible remedy*
Fuel tank empty.	Fill fuel tank. Prime carburetor with 20 to 30 strokes of fuel-pump lever.
Dirt or gum in fuel.	Clean tank (par. 56) and line (par. 55*b*).

Probable cause	*Possible remedy*
Overchoking.	Pull out choke control. Remove spark plugs from cylinders and turn engine over several times with hand crank to blow excess fuel out of spark-plug holes. Replace spark plugs (par. 68).
Wet or dirty spark plug insulator.	Wipe clean and dry.
Spark plug cracked.	Replace (par. 68).
Ignition wires loose or defective.	Tighten and inspect for cracked or damaged insulation; replace if defective (par. 67).
Fuel strainer screen clogged.	Clean the screen (par. 53*c*).
Improper ignition timing.	Retime the magneto (par. 66*d*).

32. Engine Misses or Operates Erratically

Probable cause	*Possible remedy*
Sediment or water in the fuel system.	Clean tank (par. 56) lines (par. 55), and pump. Keep tank filled. Check source of supply for purity.
Ignition wire loose.	Tighten all electrical connections.
Fouled spark plug.	Clean spark plugs and adjust gap (par. 68*b*).
Valves warped or burned.	Replace valve (par. 102).

33. Engine Lacks Power

Probable cause	*Possible remedy*
Incorrect governor adjustment.	Adjust governor. (par. 57*b*).
Improper ignition timing.	Retime the magneto (par. 66*d*).
Clogger air cleaner.	Clean and service air cleaner (par. 52).
Carburetor clogged.	Disassemble and clean carburetor (par. 86).
Carburetor choke open.	Adjust choke control (par. 9*a*).
Carburetor out of adjustment.	Adjust carburetor (par. 58*b*).
Carburetor choke not opening.	Check and adjust choke control.
Poor spark	Check spark; if spark is poor, examine magneto breaker points and clean, adjust, or replace (par. 66).
Poor compression.	Adjust valve tappets. Check for broken valve springs (par. 102).
Excessive carbon.	Remove cylinder heads and scrape carbon from top of pistons and from cylinder head (par. 101).

34. Engine Stops

Probable cause	*Possible remedy*
Fuel tank empty.	Fill tank. Prime carburetor with 20 to 30 strokes of fuel pump lever.
Water, dirt, or gum in fuel system.	Clean tank and line.
Gasoline vaporized in fuel lines due to excessive heat.	Cool the engine. Provide better ventilation.
Air breather in fuel tank plugged.	Open hole in breather.
Ignition wires loose or shorting.	Check wires for breaks or damaged insulation.
Defective distributor.	Replace magneto (par. 66).

35. Engine Overheats

Probable cause	*Possible remedy*
Crankcase oil level low.	Fill crankcase to proper lever (par. 23).
Improper ignition timing.	Retime magneto (par. 66*d*).
Air circulation restricted.	Provide proper ventilation.
Engine air shrouding incomplete.	Install correct shrouling (par. 72).
Cylinder head cooling fins dirty.	Clean fins.
Engine located in confined area.	Provide more ventilation or fresh supply of air.
Dirty or incorrect grade of crankcase oil.	Drain and refill crankcase with correct grade of oil (fig. 8).
Restricted exhaust.	Check and clean exhaust lines. Check to make sure lines are short and direct.
Clogged exhaust lines or muffler.	Clean out exhaust lines.

36. Engine Backfires

Probable cause	*Possible remedy*
Water or dirt in fuel.	Clean fuel tank, lines, and pump. Keep tank filled. Check source of fuel supply for purity.
Engine cold.	Choke engine for cold-weather starting (par. 16).

Probable cause	*Possible remedy*
Overheated or sticky valves.	Repair or replace valves (par. 102).
Lean fuel mixture.	Adjust carburetor (par. 58 *b*). Retime magneto (par. 66*d*).

37. Engine Knocks

Probable cause	*Possible remedy*
Worn or loose piston pin.	Replace (par. 111).
Connecting rod bearing loose or burned out.	Replace any worn or damaged parts (par. 110).
Carbon excessive.	Remove cylinder heads; scrape carbon from head and from top of piston. (Refer to paragraph 101).
Loose connecting rod bearings.	Install new bearings. (par. 114).
Crankshaft journals out-of-round.	Regrind or replace crankshaft (par. 117 or 118).
Misalined or twisted connecting rod.	Remove connecting rod and piston, realine and square rod and piston. (pars. 110 through 113).
Badly worn pistons and cylinder bore.	Overhaul engine and replace worn components (See ch. 4.)
Valve tappets incorrectly adjusted.	Adjust valve tappets (par. 102).
Weak or broken valve springs.	Check valve springs and replace if necessary. (par. 102).
Improper ignition timing.	Retime magneto (par. 66*d*).
Spark advanced too far.	Retime magneto (par. 66*d*).

38. Oil Consumption High

Probable cause	*Possible remedy*
Oil leaks	Check entire oil system, replace leaky gaskets and oil lines, and tighten all flanges and connections.
Worn valve guides, oil rings, cylinder walls, and pistons.	Replace worn guides, oil rings, and pistons (pars. 102 and 110 through 114).
Improper lubricant.	Drain lubricating oil and fill with proper grade (par. 23).
Worn main or connecting rod bearings.	Replace worn main or connecting rod bearings (pars. 110 through 114).
Overheated engine.	Stop engine and locate cause. Do not start engine again until normal temperature has been reached.
Main bearing oil seal.	Report dificiency to proper authority.

39. Fuel Consumption High

Probable cause	*Possible remedy*
Improper carburetor adjustment.	Adjust carburetor (par. 58*b*).
Improper timing.	Retime magneto (par. 66*d*).
Improperly set spark plugs.	Remove plugs and reset gaps (par. 68).
Valves out of adjustment.	Readjust valves (par. 102).

40. Pump Fails to Prime

Probable cause	*Possible remedy*
Leak in suction line or connections.	Tighten or replace hose or piping.
Clogged suction line.	Remove and clean suction line and pump strainer.
Suction lift too high.	Reduce lift by moving pump closer to source of supply, if possible.
Check valve stuck.	Free valve (par. 127).
Pump is air or vapor blocked.	Vent the discharge lines.
Engine not running at rated speed.	Increase engine speed.

41. Pump Fails to Deliver Capacity

Probable cause	*Possible remedy*
Impeller is worn.	Replace impeller (pars. 136 through 138).
Suction lift too high.	Place the pump closer to the level of supply.
Discharge head is too high.	Reduce total head.
Engine not running at rated speed.	Increase engine speed.
Gate valve partially closed.	Open exhaust gate valve.
Worn shaft seal.	Replace shaft seal (pars. 136 through 138).
Worn wear ring.	Replace the wear ring (pars. 136 through 138).

42. Noisy Pump Operation

Probable cause	*Possible remedy*
Improper installation.	Reset pump.
Shaft seal worn.	Replace the shaft seal (pars. 136 through 138).

Probable cause	*Possible remedy*
Worn impeller.	Replace impeller (pars. 136 through 138).
Clogged pump strainer.	Remove and clean strainer.

43. Pump Overheats

Probable cause	*Possible remedy*
Suction greater than discharge.	Open gage valves on the discharge manifold.
Impeller clogged with sediment.	Clean and flush the pump.

44. Not Enough Pressure

Probable cause	*Possible remedy*
Worn impeller.	Replace impeller (pars. 136 through 138).
Engine not running at rated speed.	Increase engine speed.
Valves not fully opened.	
Worn wear ring.	Replace the wear ring (pars. 136 through 138).
Worn or damaged shaft seal.	Replace shaft seal (pars. 136 through 138).
Leak in hose.	Replace hose.
Loose connection suction line.	Tighten connection.

Section V. RADIO SUPPRESSION

45. Definition of Radio Suppression

Radio suppression is the effective elimination of electrical disturbances within the equipment wihch interfere with radio reception, and disclose the location of the pump and the other components of the installation to sensitive electrical detectors.

46. Suppression Component Replacement

a. General When replacing suppression material it is necessary to replace defective components with identical parts. Any shielding or any engine accessory which is shielded for radio suppression must be grounded and secured with screws and lockwashers. Grounding contacts must be clean and tight for satisfactory interference suppression.

b. Engine suppression material.

(1) *Spark plugs.* Each spark plug is self-shielded with one 10,000-ohm resistor-suppressor inserted at the plug end of each high-tension lead. Always replace with the same type when changing plugs. Each cable assembly is covered with a thin copper braid which must be grounded at both ends of the lead for proper suppression. See that the plugs and leads are clean and tight.

(2) *Magneto.* The magneto is bonded to the engine front cover with lockwashers and cap screws. A ground wire from the magneto frame to the crankcase provides a good ground.

47. Sources of Interference

The spark plugs, ignition wires from magneto to spark plugs, and poor electrical connections are common sources of electrical interference.

48. Methods Used to Suppress Interference

a. General. The following three methods are used to suppress radio interfernce caused by the unit:

(1) Capacitors.
(2) Bonding.
(3) Shielding.

b. Capacitors. The capacitors are units of metal foils separated by paper insulation and protected by a metal case filled with an impregnation compound to keep moisture out. The capacitor is attached to the circuit as close as possible to the point at which the spark occurs. A capacitor allows the interfering voltage to pass freely to ground, and, at the same time, prevents loss of useful current.

c. Bonding. Bonding is accomplished by internal-external-toothed lockwashers and by bond straps. Bonding is necessary to provide an easy path for grounding static charges. The better the connection between metal parts, the greater is the effect in preventing interfering waves from being broadcasted to affect radio reception.

d. Shielding. Shielding is accomplished by covering with metal shields or boxing all wiring and units causing interference. This shielding does not reduce the intensity of the interfering surges, but prevents broadcasting. Woven metal conduit is used where flexibility is required, while solid conduit is used elsewhere.

49. Effects of Suppression

There is no interference from equipment satisfactorily suppressed for broadcasted interference over the frequency range of 0.55 through 156.0 50. megacycles at a distance of 25 feet from the unit.

50. Suppression System Testing

This testing is performed by 3d echelon or higher.

a. Install a battery-powered radio receiver in good operating condition not more than 10 feet from the pump. A wide band receiver covering the frequency ragnge of 0.55 to 156.0 megacycles is preferred.

b. Start the equipment and turn on the receiver. Turn the receiver volume to maximum and select three widely separated frequencies for listening. Use frequencies that are free from signals with strong carriers so that the receiver will be in its most sensitive operating condition.

c. Systematically replace suppression components in the circuit causing trouble, testing after the replacement of each component to see if the trouble has been eliminated.

Section VI. ENGINE FUEL SYSTEM

1 Pump-to-carburetor fuel line
2 Fuel strainer
3 Tank-to-strainer fuel line
4 Cap screw and lockwasher
5 Adapter
6 Allen head screw
7 Priming lever
8 Fuel pump

Figure 9. Engine fuel pump, installed view.

51. Description

The engine fuel system consists of a fuel tank, fuel pump, fuel strainer, fuel-pump adapter, and hand primer, carburetor, governor, air cleaner, and fuel lines and connections. Fuel is drawn from the tank to the strainer, which removes solids and water from the fuel. The strained fuel passes through the fuel pump and into the carburetor. The oil-bath air cleaner removes any dust, water, or foreign matter from the air, and passes clean air to the carburetor to be mixed with the fuel for proper combustion.

52. Air Cleaner

a. General. The air cleaner is of the oil-bath type. Air enters the cleaner through the top, then passes over the oil in the cup and through the body screen, where any solids or water present are left behind. The filtered air then passes through the air pipe to the carburetor. Figure 10 shows an exploded view of the air cleaner.

b. Removal (fig. 10).

(1) Loosen the screw in the hose clamp (1) at the carburetor; remove the elbow (2) from the carburetor and lift off the spacer.

(2) Loosen the screw in the hose clamp (1) at the air-cleaner body (6); remove the hose (4) from the air cleaner.

(3) Remove the four cap screws (12), lockwashers (11), and hex nuts (10) securing the mounting strap (13) to the front engine panel; remove the assembled air cleaner and mounting bracket.

c. Disassembly.

(1) Loosen the three machine screws (7), lockwashers (8), and hex nuts (9); remove the mounting strap (13) from the air-cleaner body (6).

(2) Loosen the screw on the oil cup clamp (15) enough so that the oil cup (14) can be twisted to the left until it can be removed from the body.

(3) Remove the cap (5) from the body.

d. Cleaning and inspection.

(1) Wash the air-cleaner body (6), oil cup (14), and mounting strap (13) in an approved cleaning solvent. If necessary, allow the air-cleaner body (6) to soak several hours.

(2) Inspect all parts for dents or other damage; replace any damaged parts. Examine the air-cleaner body (6) closely for evidence of dirt and foreign matter.

(3) Inspect the air tube (3) for cracks or breaks; replace the air tube if it is worn or damaged. Be sure that the hose clamps (1) and the oil cup clamp (15) are not bent or damaged. Replace any damaged or missing parts.

e. Reassembly.

(1) Place the cap (5) in place on the air-cleaner body (6).

(2) Fill the oil cup (14) to the oil level line with the same grade of oil used in the engine crankcase, and install the oil cup in place on the body.

(3) Secure the oil cup by placing the oil cup clamp (15) in place and tightening the screw.

(4) Position the mounting strap (13) on the air-cleaner body (6) and secure it around the body with the machine screws, lockwashers, and hex nuts.

f. Installation.

(1) Position the assembled air cleaner and mounting bracket in place; secure it in the exact location as it was before removal with the cap screws, lockwashers, and hex nuts.

(2) Install the air tube (3) in the air cleaner and on the carburetor; secure it in place with the four air-hose clamps (1), hose (4), and elbow (2). Under dusty conditions the air cleaner must be serviced more frequently.

53. Fuel Strainer

a. Description. The fuel strainer is located on the right side of the engine, above the crankcase fill and breather. Fuel from the fuel tank is delivered to the fuel strainer, then passes through the sediment bowl and up through the filter element, which removes dirt and water from the fuel.

b. Removal and disassembly (fig. 11).

(1) Remove the fuel strainer sediment bowl (6), spring (5), filter element (4), and the gasket (3) from the body (1) by loosening the clamp assembly thumbnut and removing the clamp assembly (7).

(2) Disconnect the fuel line from the fitting on the fuel strainer; remove the fitting.

(3) Unscrew the strainer body (1) from the connection to the fuel pump.

c. Cleaning and inspection.

(1) Wash the removed parts with an approved cleaning solvent; dry thoroughly.

(2) Inspect the sediment bowl for cracks. Replace a defective sediment bowl.

(3) Blow out the strainer body with compressed air. Use a soft wire to probe any clogged passages.

(4) Blow out the fuel lines with clean. dry compressed air. Examine the fuel lines for kinks, breaks, and other damage. Replace a defective fuel line.

(5) Check the strainer body for cracks, breaks, and bad threads; replace the strainer body if it is defective or damaged.

(6) Inspect the filter element (4) for tears or clogged mesh. Clean the filter element or replace it if necessary.

d. Reassembly and installation.

(1) Screw the slotted pipe nipple (2) into the strainer body (1). Secure the strainer body in a suitable vise, holding it by the hexagonal part of the body.

(2) Screw the fitting into the strainer body (1).

(3) Install the strainer body (1) into position by screwing it into the fuel-pump connection.

(4) Connect the fuel line to the fitting.

(5) Install the sediment bowl (5), gasket (3), and filter element (4), and secure by means of the clamp assembly (6). Check the entire fuel strainer assembly and be sure that it is correctly assembled and installed and that each connection is tight.

54. Fuel Pump, Fuel Pump Adapter, and Hand Primer Assembly

a. General. The fuel pump contains a flexible diaphragm which acts to pump fuel from the fuel tank to the carburetor. The diaphragm is pulled down by a rocker arm and link which is actuated by the plunger in the fuel-pump adapter. A spring forces the diaphragm back up to force fuel to the carburetor. The adapter contains a plunger that rides on an eccentric of the camshaft, and a built-in lever for hand priming the carburetor.

1 Hose clamp
2 Elbow
3 Air tube
4 Hose
5 Cap
6 Body
7 Screw
8 Lockwasher
9 Hex nut
10 Hex nut
11 Lockwasher
12 Cap screw
13 Mounting strap
14 Oil cup
15 Oil cup clamp

Figure 10. Air Cleaner, exploded view.

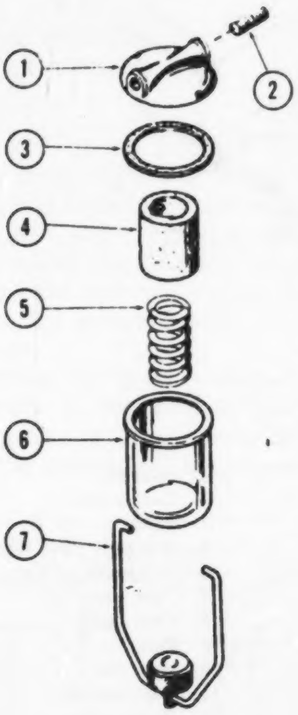
b. Removal (fig. 9).

(1) Remove the engine housing canopy and partition plate.

(2) Remove the fuel strainer (par. 53*b*).

(3) Disconnect the primer control from the priming lever (7).

(4) Disconnect the fuel line (1) from the carburetor and fuel pump; cap the carburetor fitting. Be sure that no dirt or other foreign matter enters the fuel system.



1 Body
2 Pipe nipple
3 Gasket
4 Filter element
5 Spring
6 Sediment bowl
7 Clamp assembly

Figure 11. Fuel strainer, exploded view.

(5) Remove the two cap screws and lockwashers (4) that secure the fuel pump (8) to hte adapter (5); remove the fuel pump (8) and gasket.

(6) Remove the two Allen-head screws (6) and lockwashers that secure the adapter to the crankcase. Lift away the adapter (5), and cover the plunger hole in the crankcase.

c. Cleaning and inspection.

(1) Clean all parts in an approved solvent; dry thoroughly.

(2) Examine each part for evidence of cracks, breaks, or other visible damage.

(3) Inspect the fittings and be sure that the fuel lines are not damaged when the fuel pump or adapter is removed or installed.

d. Installation.

(1) Remove the seal from the hole in the crankcase; position the fuel-pump adapter and its gasket, and secure with the two Allen-head screws and lockwashers.

(2) Place a new gasket between the fuel pump and adapter; secure the fuel pump to the adapter with two cap screws and lockwashers.

(3) Remove the seal from the carburetor fitting and connect the fuel line to the carburetor and fuel pump.

(4) Install the fuel shutoff valve and fuel strainer (par. 53*d*).

(5) Install the engine housing canopy and partition plate.

(6) Run the engine for a short time and check for leaks; tighten any loose connections.

55. Fuel Lines

a. Removal (fig. 12).

(1) Place a clean container underneath the fuel tank (8), and open the drain cock (12); drain all the fuel into the container.

(2) Loosen the compression nut (6), and remove the fuel line (7) from the fuel tank connection; remove the inverted male elbow (5).

(3) Loosen the other compression nut (6) and remove the fuel line from the connection at the fuel strainer.

(4) Loosen the connector nuts at the ends of the remaining fuel line and remove the fuel lines; remove both fittings.

b. Cleaning and inspection.

(1) Wash all the fuel lines and fittings in an approved cleaning solvent, and dry thoroughly.

(2) Blow each fuel line out with clean, dry compressed air.

(3) Inspect the threads and the condition of each fitting; replace damaged or worn fittings.

(4) Inspect the fuel lines for cracks, bends, or breaks; replace any fuel line that is damaged.

c. Installation.

(1) Install the fittings in place on the fuel tank, fuel pump, and carburetor.

(2) Position the fuel lines, one at a time, and tighten the fittings, reversing the procedure in *a* above.

(3) After all the lines have been installed, check them carefully for leaks at the fittings; tighten leaking connections.

56. Fuel Tank

a. Removal (fig. 12).

(1) Take off the cap (1), remove the gasket (2), and lift out the strainer (14).

(2) Remove the fuel lines as instructed in paragraph 55*a*.

(3) Remove the four hex nuts (10), lockwashers (11), and cap screws (3) that secure the straps (4) in place; remove the straps and felt.

(4) Lift the fuel tank (8) from the pump.

b. Cleaning and inspection.

(1) Wash the interior and exterior of the fuel tank; dry thoroughly.

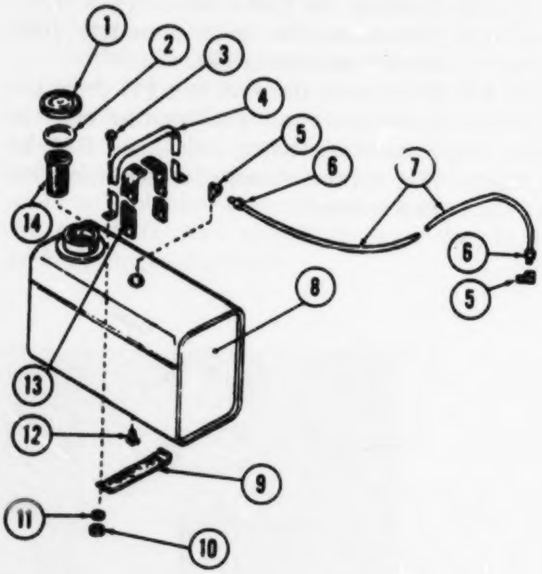
(2) Clean the metal straps and the attaching parts.

(3) Examine the felt for worn spots and tears; replace the felt if it is excessively worn.

(4) Inspect the fuel tank for cracks, dents, or weak spots which might cause leaks; repair or replace a damaged fuel tank.

(5) Replace any missing or damaged mounting components.

Note. Do not weld an empty or partially full tank.



1	Cap
2	Gasket
3	Cap screw
4	Strap
5	Inverted male elbow
6	Compression nut
7	Fuel line
8	Fuel tank
9	Felt
10	Hex nut
11	Lockwasher
12	Drain cock
13	Felt
14	Strainer

Figure 12. Fuel tank, exploded view.

c. Installation.

(1) Place the two pieces of felt (9) in position and lower the fuel tank (8) in the same position it was in before removal.

(2) Place the other two pieces of felt (13) around the fuel tank and place the two straps (4) in position.

(3) Secure each strap in place with the attaching parts.

(4) Install the strainer and the fuel tank cap with its gasket and install the fuel lines as instructed in paragraph 55*c*.

(5) Close drain cock (12) in bottom of tank.

(6) Tighten each fitting and fill the fuel tank and check for leaks.

57. Governor

a. General. The engine governor is of the centrifugal fly-weight type, is driven by the camshaft gear, and functions to maintain a constant engine speed under varying load conditions. The governed engine speed can be adjusted by fitting the governor spring to one of the 12 holes in the governor lever.

b. Adjustment.

(1) Determine the desired engine speed, and refer to figure 13 for the proper spring hole in the governor lever; insert the spring into the proper hole.

LOAD R.P.M.	NO LOAD R.P.M.	HOLE NO.
1400	1550	4
1500	1650	5
1600	1725	5
1700	1850	6
1800	1950	7
1900	2025	7
2000	2125	8
2100	2250	9
2200	2350	10

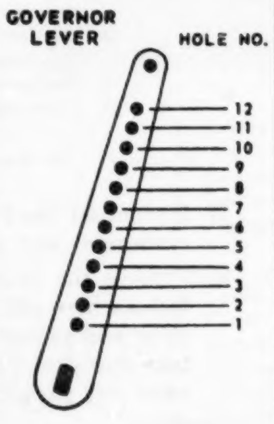


Figure 13. Governor adjustment table.

(2) Take up on the locknut at the end of the adjusting rod (9, fig. 14) until the spring (8) is horizontal to the engine.

(3) Remove the nut (4) and lockwasher from the ball joint on the governor control rod (6). Push the rod toward the carburetor to open the throttle valve. Adjust the positions of the ball joints on the control rod until the stud of the ball joint is aligned with the top hole in the governor lever (7). Install the nut (4) and lockwasher to secure the ball joint to the governor lever.

c. Removal.

(1) Remove the nut (4, fig. 14), and pull the governor control rod (6) out of the governor lever (7).

(2) Disconnect the governor spring (8) from the governor lever.

(3) Disconnect the oil line (10) from the pipe nipple on the governor. Disconnect the tachometer adapter (12) from governor.

(4) Remove the four cap screws (2) and lockwashers (3) that secure the governor housing (1) to the gear cover (5); remove the governor and its gasket.

(5) Unscrew the pipe nipple (13) from the governor housing.

d. Cleaning and inspection.

(1) Clean the governor housing and remove fittings with an approved cleaning solvent; dry thoroughly.

(2) Inspect the governor drive gear for broken or chipped teeth; replace the governor if necessary.

(3) Inspect the governor control rod and adjusting rod for good condition. Replace them if they are bent or otherwise unserviceable.

(4) Inspect the governor housing for cracks or breaks; replace a damaged governor, or report the condition to the proper authority.

(5) Inspect the removed fitting for good threads. Replace any damaged fitting.

e. Installation (fig. 14).

(1) Install the pipe nipple (13) into the governor housing.

(2) Position the governor housing (1) and gasket against the gear cover (5) being careful to engage the governor drive gear with the camshaft gear; secure with the four cap screws (2) and lockwashers (3).

(3) Install governor control rod (6), lever (7), and spring (8). Secure with nut (4).

(4) Install the filter oil line (10) and the tachometer adapter (12) on the governor.

58. Carburetor

a. General. The carburetor is a float type carburetor with an idle fuel adjustment. The carburetor is designed with two major units - a die cast aluminum throttle body and a stamped steel fuel bowl. Figure 15 shows the carburetor installed.

b. Idle adjustment.

(1) Remove the cotter pin (10) securing the governor control rod (11) to the governor lever; pull the control rod loose from the governor lever.

(2) Start the engine (par. 12) and let it run until it reaches its operating temperature; push the choke control in.

(3) Move the governor control rod until the engine runs at idle speed. Turn the idle adjusting screw (7) out until the engine falters; slowly turn in the screw until the engine runs smoothly; stop the engine. The idle adjusting screw should be in proper adjustment at about 3/4 to a full turn open.

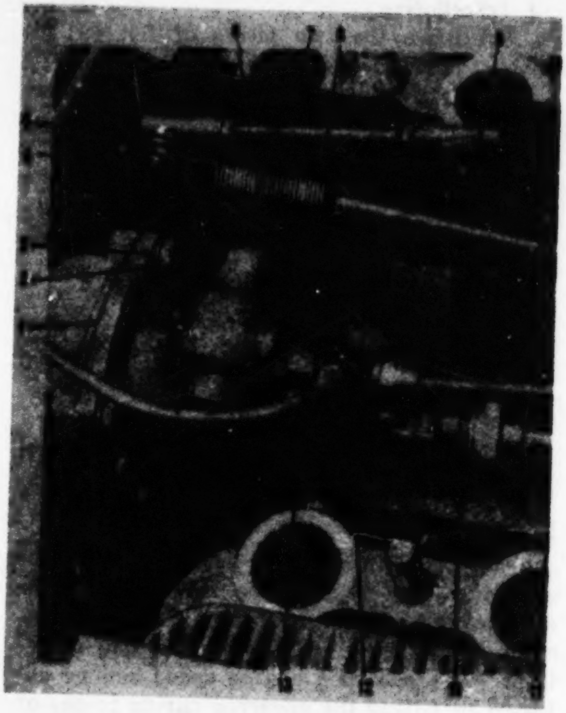
(4) Connect the governor control rod to the governor lever; secure the rod with the cotter pin.

c. Removal (fig. 15).

(1) Loosen the choke lever swivel screw (8), and pull out the choke control wire (9).

(2) Disconnect the governor control rod (11) from the governor lever, and unscrew it from the throttle shaft assembly and stop lever (2).

(3) Remove the air cleaner hose from the carburetor (par 52*b*.).



1	Governor housing
2	Cap screw
3	Lockwasher
4	Hex nut
5	Gear cover
6	Governor control rod
7	Governor lever
8	Governor spring
9	Adjusting rod
10	Oil line
11	Tachometer flexible shaft
12	Tachometer adapter
13	Pipe nipple

Figure 14. Governor installation.

(4) Disconnect the fuel line (6) from the carburetor and seal it.

(5) Remove the two cap screws (3) and lockwashers (4) that secure the carburetor and gasket (5) to the engine intake manifold (1); remove the carburetor and gasket.

d. Installation.

(1) Place a new gasket (5) between the carburetor and the intake manifold

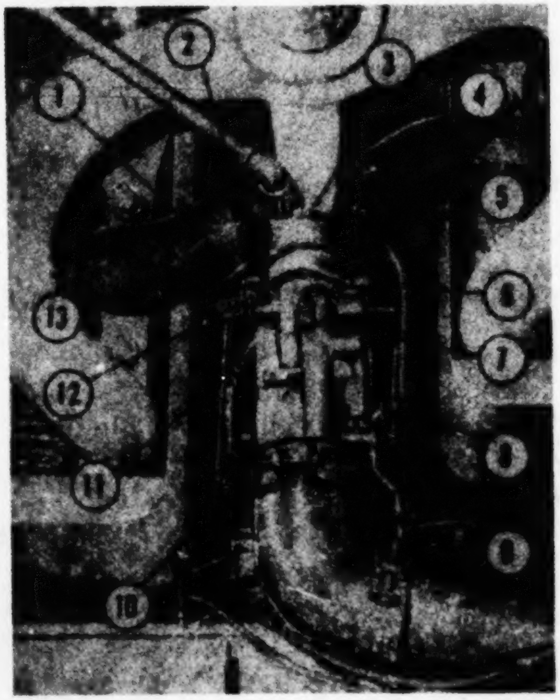
(1); secure the carburetor to the manifold with two cap screws (3) and lockwashers (4). Be sure that all the mounting surfaces are clean.

(2) Remove the seal from the fuel line (6); connect the line to the carburetor. Take care that dirt or foreign matter does not enter the fuel system.

(3) Insert the choke control wire (9) in the hole of the choke lever. Operate the lever so that the choke is open wide, and with the choke control on the front panel all the way in, tighten the choke swivel screw (8).

(4) Install the air-cleaner hose.

(5) Attach the governor control rod (11) to the throttle shaft assembly and stop lever (2). Adjust the length of the rod (par. 57*b*).



1 Intake manifold
2 Throttle shaft assembly and stop lever
3 Cap screw
4 Lockwasher
5 Flange gasket
6 Fuel line
7 Idle adjusting screw
8 Choke swivel screw
9 Choke control wire
10 Cotter pin
11 Governor control rod
12 Throttle adjusting screw
13 Throttle adjusting screw spring

Figure 15. Carburetor installation.

Section VII. LUBRICATION SYSTEM

59. Description

A gear type pump supplies oil to four nozzles which direct oil streams against fins on the connecting-rod caps. Part of the oil enters the rod bearing through holes in the rods, and the balance of the oil forms a spray or mist which lubricates the cylinders and all other parts of the engine.

60. Oil Filter

a. General. The oil filter is mounted on the upper left side of the flywheel shroud. A portion of the lubricating oil entering the governor is diverted through the filter, where any suspended solids are removed.

b. Removal (fig. 16).

(1) Loosen the cap screw (1) and remove the assembled cap screw, cover (3), cap screw gasket (2), and cover spring (4) from the filter body assembly (12). Remove the cover gasket (5).

(2) Remove the drain plug (13) to drain the sludge from the body assembly. Remove the cartridge (6).

(3) Disconnect the oil pressure line and the oil return line from the elbows on the body assembly. Remove the two cap screws, nuts, and lockwashers that secure each of the straps (7) to the engine; remove the assembled filter and straps. Remove the bolt (8), nut (9), and lockwasher (10) and remove the straps from the body assembly.

c. Cleaning and inspection.

(1) Clean all parts except the cartridge in an approved cleaning solvent; dry thoroughly.

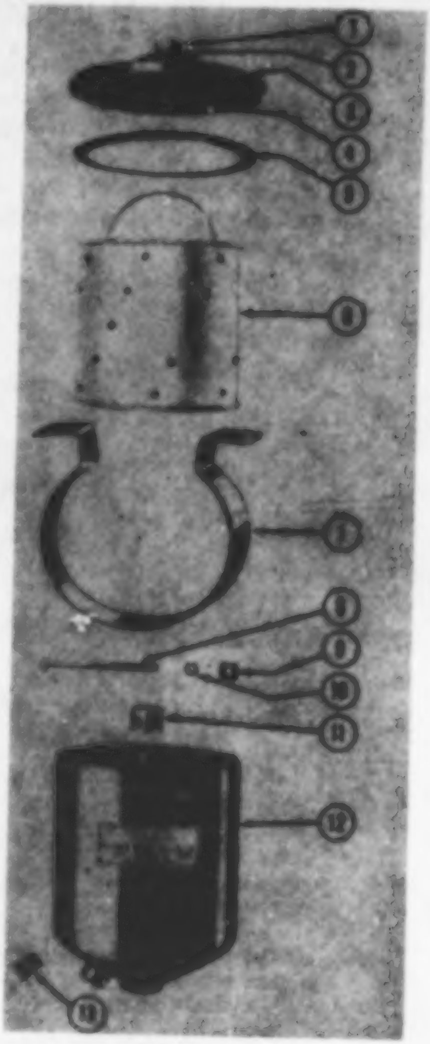
(2) Inspect the filter body for breaks cracks, or dents; replace damage parts.

(3) Replace a dirty or unserviceable filter cartridge.

d. Installation.

(1) Use a new cover gasket when installing the cover.

(2) After installation, start the engine and allow it to run for a few minutes. Examine the filter assembly and connections for leaks.



1	Cap screw
2	Cap screw gasket
3	Cover
4	Cover spring
5	Cover gasket
6	Cartridge
7	Strap
8	Bolt
9	Nut
10	Lockwasher
11	Spacer
12	Filter body assembly
13	Drain plug

Figure 16. Oil filter, exploded view.

Section VIII. MUFFLER AND MANIFOLD

61. Description

a. Muffler. The muffler (2, fig. 17) is mounted at the top of the engine and equipped with a weather cap (1). The muffler is connected to the manifold (9) with a pipe nipple (14) and muffler clamp (3).

b. Manifold. The manifold assembly (9) is of single casting and is a combination exhaust and intake manifold. The manifold is mounted on the engine cylinder block and secured with studs (11), nuts (7), and lockwashers (8).

62. Muffler

a. Removal. Remove the muffler clamp (3) and lift off the muffler (2) from the pipe nipple (14) on the manifold assembly (9).

b. Cleaning and inspection. Inspect the muffler for breaks, dents, corrosion, or carbon deposits which may restrict the flow of exhaust gases. Remove any dirt, carbon, or foreign material. Replace an unserviceable muffler.

c. Installation. Follow the procedures in *a* above in the reverse manner.

63. Manifold

a. Removal.

(1) Remove the muffler (par. 62).

(2) Remove the carburetor (par. 58*c*).

(3) Remove the nuts (7, fig. 17) and lockwashers (8) and flexible hose (6).

(4) Lift off the manifold assembly (9) from the cylinder block. Remove the gaskets (13) and manifold gasket inserts (12).

b. Cleaning and inspection.

(1) Clean the manifold with a wire brush to remove any rust or other foreign material.

(2) Examine the manifold for cracks or breaks; replace a defective manifold.

(3) Check the manifold to cylinder block gaskets and insert. Replace them if they were damaged during the removal of the manifold.

c. Installation. Reverse the procedures outlined in *a* above. Torque manifold nuts to 40-50 foot-pounds.

Section IX. IGNITION SYSTEM

64. Description (fig. 18)

The spark for ignition of the fuel-air mixture in the cylinders is furnished by a high-tension, radioshielded magneto (9), driven by the timing gears at crankshaft speed. The magneto distributor plate electrodes are connected to the proper spark plugs according to the engine firing order (1-3-4-2). At the instant the distributor rotor electrode makes contact with the distributor plate electrode, a surge of current travels through the spark plug cable (1 to fire the proper cylinder at the correct time.

65. Ignition Spark Test

a. Pull all of the ignition cables out of the magneto end cover, and insert an insulated wire, bared at both ends, into one of the terminal posts.

b. Push the ignition switch in, and crank the engine with the starting crank. With the bared end of the wire held one-eight inch away from the cylinder head shroud, an intense blue spark should be observed.

c. Continue the test by inserting the wire in the three remaining terminal posts of the magneto.

d. If no spark is observed, disconnect the lead wire connecting the magneto to the ignition switch. Retest for spark, and if a spark is observed at this point, the ignition switch is at fault and must be replaced.

e. If no spark is observed in the procedures outlined in *a* through *d* above, repair the breaker points and replace the capacitor in the magneto (par. 66), or replace the magneto as necessary.

66. Magneto

a. General. The magneto is a four-pole rotor, four-pole cam type, producing four sparks per revolution of the rotor, which rotates at crankshaft speed. In a complete cycle of two engine revolutions, four sparks are used for ignition. The magneto has a standard mounting flange with a special coupling and drive gear arrangement which requires an extended rotor shaft.

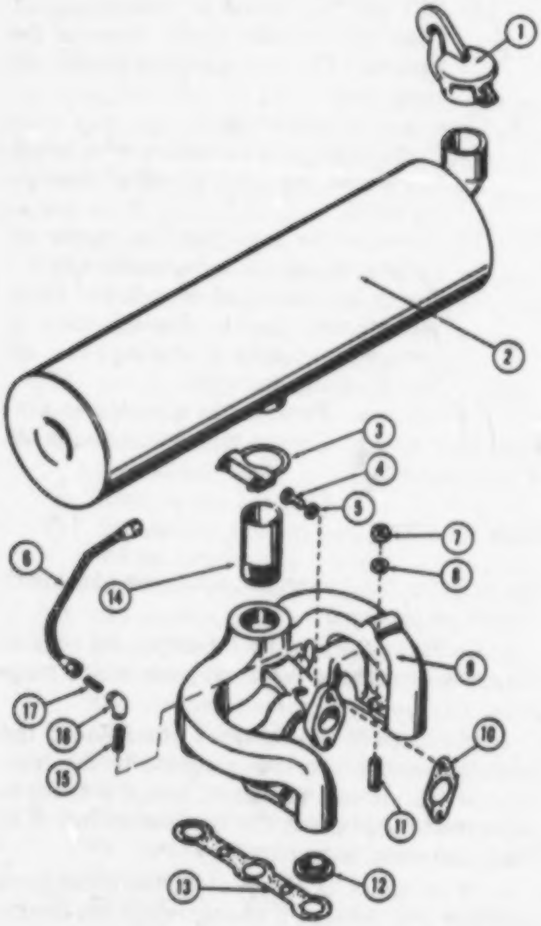


Figure 17. Muffler and manifold, exploded view.

1	Weather cap
2	Muffler
3	Muffler clamp
4	Capscrew
5	Lockwasher
6	Flexible hose
7	Nut
8	Lockwasher
9	Manifold assembly
10	Carburetor mounting gasket
11	Stud
12	Manifold gasket insert
13	Manifold to cylinder block gasket
14	Nipple
15	Nipple
16	Elbow
17	Nipple

Figure 17—Continued.

b. Removal (fig. 18).

(1) Disconnect the spark plug cables (1), ignition switch wire, and ground strap (2) from the magneto (9).

(2) Remove the two nuts (5), lockwasher (7), plain washer, and capscrew (8) securing the magneto to the engine; remove the magneto and its gasket (3).

c. Cleaning and inspection.

(1) Clean the exterior of the magneto with an approved cleaning solvent; dry thoroughly.

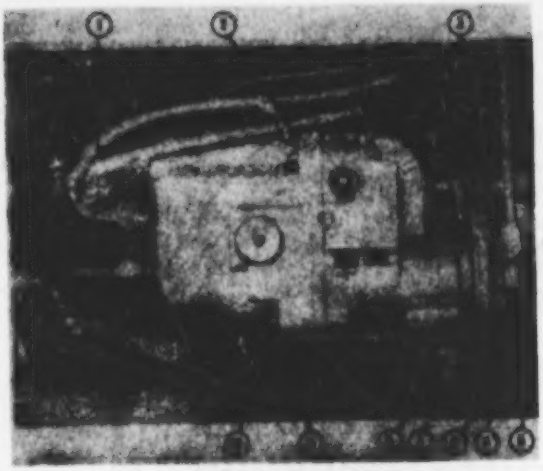
(2) Inspect for loose screws and damaged parts. Tighten loose screws; replace a damaged magneto.

(3) Inspect the flange gasket for tears or deterioration. Replace a defective gasket.

d. Timing and installation.

(1) Remove the spark plug from No. 1 cylinder (see timing diagram (fig. 19); slowly crank the engine until air begins to blow out of the plug hole, indicating that the piston is on the compression stroke.

(2) Continue cranking the engine until the marked flywheel vane (fig. 19) is in line with the mark on the flywheel shroud.



1 Spark plug cable
2 Ground strap
3 Flange gasket
4 Elbow
5 Nut
6 Magneto mount
7 External tooth lockwasher
8 Capscrew
9 Magneto
10 End cover screw

Figure 18. Magneto, installed view.

(3) Remove the elbow (4, fig. 18) from the gear cover, and turn the magneto drive gear so that when the magneto is positioned on the engine, and its drive gear is engaged with the gear train, the marked gear tooth is visible through the inspection hole.

(4) Secure the magneto (9) with the capscrew (8), plain washer, lockwashers (7), and two nuts (5).

(5) Connect the spark plug cables (1) and ground strap (2) to the magneto.

(6) Install the elbow (4).

e. Cleaning magneto breaker points.

(1) Remove the four screws (10, fig. 18) and lockwashers that secure the magneto and cap to the magneto housing.

(2) Carefully remove the end cap with the ignition switch wire and spark plug cables in place; remove the distributor rotor.

(3) Inspect the points on the breaker arms (fig. 20) for pitting and burning; replace burnt or badly pitted breaker points (see *g* below).

(4) Use a breaker point file or stone to dress the breaker points; adjust the point gap (see *f* below).

(5) Inspect the gasket for tears or other damage. To replace the gasket, remove the two screws that secure the extension plate to the magneto housing, position the extension plate on the housing, and secure with the two screws.

f. Adjusting breaker point gap.

(1) Slowly crank the engine until the points on the breaker arms (fig. 20) are fully open; measure the gap with a feeler gage. The gap should measure 0.015 inch.

(2) Adjust the gap by loosening the locking screws, inserting a screwdriver into the adjusting slot at the bottom of the contact plate and turning. Tighten the locking screws. Recheck the gap.

g. Replacing breaker points and capacitor.

(1) Remove the terminal screw and lockwasher that secure the coil lead and breaker arm spring to the contact support. Remove the snap ring, and lift out the breaker arm.

(2) Remove the two locking screws, lockwashers, and plain washers securing the contact plate; remove the contact plate.

(3) Position the new contact plate on the magneto bearing support, and loosely install the two locking screws.

(4) Install a new breaker arm over the pin of the bearing support and secure with the snap ring.

(5) Position the breaker arm spring against the contact support; secure the spring and coil lead to the support with the terminal screw and lockwasher.

(6) Adjust the breaker point gap (see *f* above) and tighten the two locking screws.

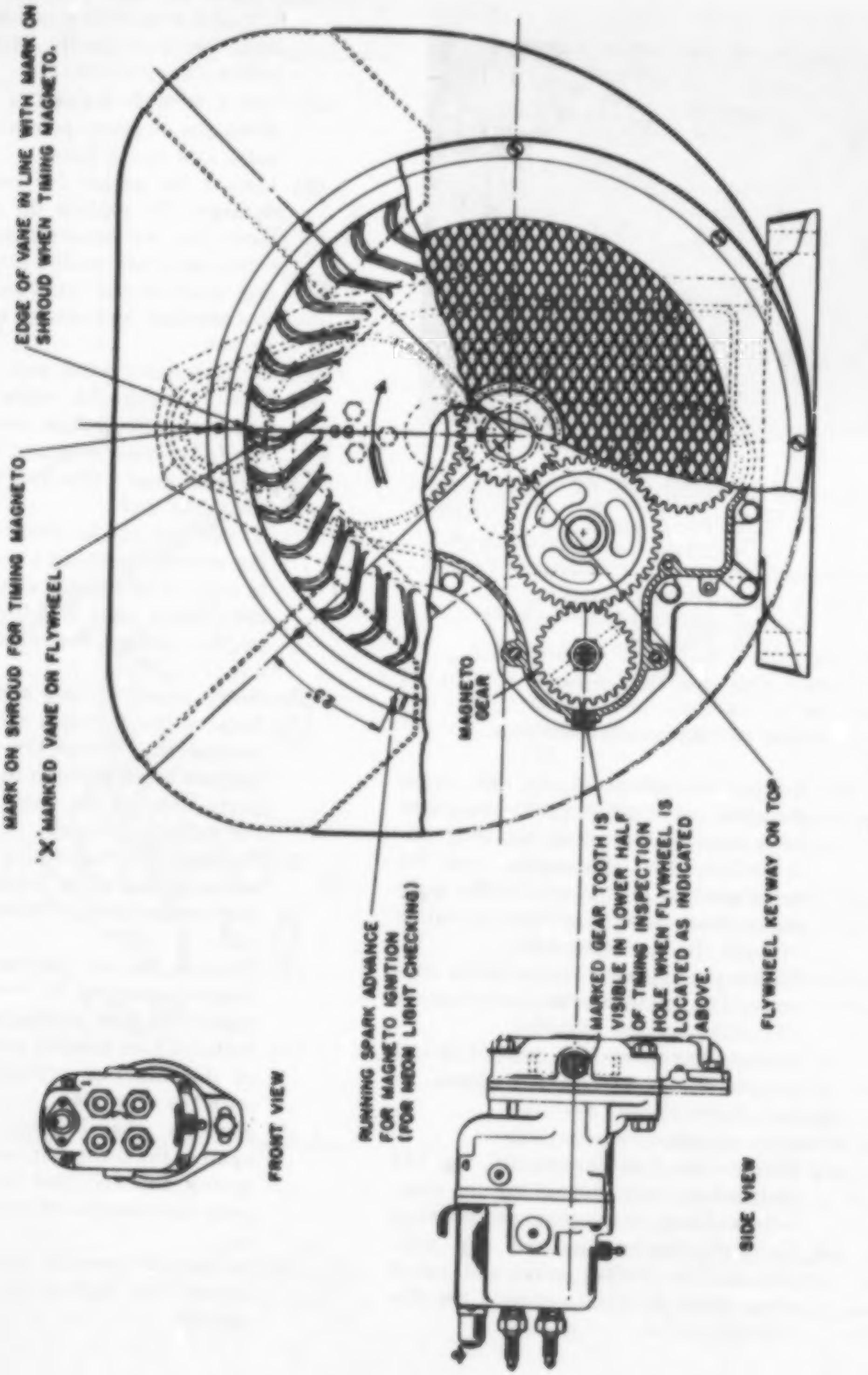

FIRING ORDER 1-3-4-2
EDGE OF VANE IN LINE WITH MARK ON SHROUD WHEN TIMING MAGNETO.
MARK ON SHROUD FOR TIMING MAGNETO
'X' MARKED VANE ON FLYWHEEL
23°
RUNNING SPARK ADVANCE FOR MAGNETO IGNITION (FOR NEON LIGHT CHECKING)
MAGNETO GEAR
MARKED GEAR TOOTH IS VISIBLE IN LOWER HALF OF TIMING INSPECTION HOLE WHEN FLYWHEEL IS LOCATED AS INDICATED ABOVE.
FLYWHEEL KEYWAY ON TOP
FRONT VIEW
SIDE VIEW

Figure 19. Engine timing marks.

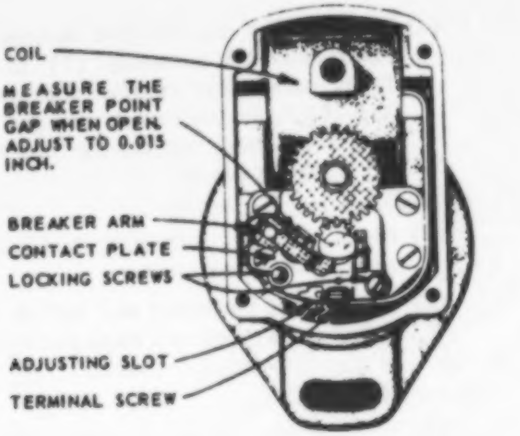


Figure 20. Magneto breaker points.

(7) Position the end cap on the magneto housing, and secure the end cap and ground strap (2, fig. 18) with the four screws (10) and lockwashers.

67. Spark Plug Cables

a. Removal.

(1) Tag all spark plug cables so that they will be reinstalled on the same spark plugs (the cables are different in length).

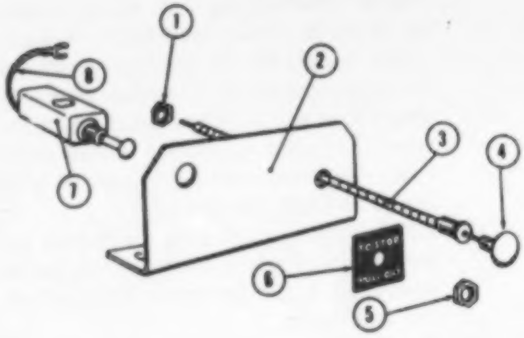
(2) Disconnect the cables from the magneto and spark plugs. Remove the screws that secure the clips to the air shrouds; remove the cables and loom assemblies from the engine.

b. Cleaning and inspection. Wipe the cable and loom assemblies with a cloth dampened with an approved cleaning solvent. Inspect the cable sheathing for breaks. Examine the loom assemblies for corrosion. Replace any defective spark plug cables.

c. Installation. Connect the spark plug cables to the spark plugs and magneto. Install the clips.

68. Spark Plugs

a. Removal. Disconnect the cables assemblies from the spark plugs. Blow out the spark plug wells in the cylinder heads, and remove the spark plugs with the spark plug wrench. Lift out the gaskets (17), and plug the spark plug holes with corks or wooden pegs.



1	Nut
2	Panel
3	Choke wire
4	Choke control
5	Nut
6	Switch tag
7	Ignition switch assembly
8	Wire to magneto

Figure 21. Front control panel, exploded view.

b. Cleaning and inspection.

(1) Wipe the exterior of the spark plugs clean with a cloth dampened with an approved cleaning solvent.

(2) Examine the firing ends of the plugs, noting the type of deposit. Wet, sludgy deposits indicate excessive clearance between the valve guides and stems, or that excessive amounts of oil are entering the combustion chamber through worn rings. A dry, fluffy deposit indicates incomplete combustion; check the magneto and spark plug cables for defects that would result in too cold a spark. Burned or overheated plugs are indicated by a burned insulation nose around the center electrode and badly eroded electrodes. Check the air

shrouds and cooling fins for causes of engine overheating. A rusty brown or grayish-white powdery deposit, when unleaded or regular gasolines have been used, or a white powdery deposit, when highly leaded gasolines have been used is normal. Clean away from the electrodes, and use a wire brush to clean the threads.

(3) Examine the spark plug electrodes for pitting. Replace a badly pitted spark plug; use a file to repair slightly pitted electrodes.

(4) Set the gap of the spark plugs to 0.030 inch by bending the side electrodes.

c. Installation. Remove the temporary plugs from the spark plug holes, slip a gasket over each spark plug, and install the spark plug. Tighten the plugs to 25-30 foot-pounds torque. Connect the loom assemblies to the plugs.

69. Ignition Switch

a. Removal (fig. 21).

(1) Disconnect the ignition switch wire at the magneto.

(2) Unscrew the nut (5) that secures the ignition switch assembly (7) to the front panel (2); remove the switch tag (6) from the switch and pull the switch assembly out through the rear of the front panel.

b. Cleaning and inspection.

(1) Clean the parts with a cloth dampened with cleaning solvent.

(2) Inspect the hardware and switch for bad threads; replace a damaged switch or any defective hardware.

c. Installation.

(1) Position the switch assembly (7) on the rear of the front panel (2) so that the threaded portion of the switch extends through the front panel.

(2) Slip the tag (6) over the extended threaded neck of the switch assembly, and secure the switch with the nut (5).

(3) Connect the ignition switch wire to the magneto.

Section X. ENGINE COOLING SYSTEM

70. Description

A combination fan and flywheel forces a flow of air through the flywheel shroud to circulate around the cylinders and cylinder heads. Air shrouds are provided to direct the flow of air.

Caution: **Never operate the engine with any part of the shrouding removed. To do so will cause engine to overheat and be damaged.**

71. Engine Fan (Flywheel)

a. Removal.

(1) Remove the eight screws (5, fig. 22) and lockwashers (4) that secure the flywheel screen (15) to the flywheel shroud (7); remove the flywheel screen.

(2) Examine the hole in the end of the crankshaft for a crank pin setscrew. Remove the setscrew if one is present.

(3) Drive the crank pin (22) out of the crankshaft.

(4) The lockwasher (11) has two of its tines bent over the nut (12). Position a screwdriver against the tines, and drive them back. Remove the nut from the crankshaft (23).

(5) Hit the end of the crankshaft with a soft hammer to loosen the flywheel. If the flywheel is not loosened after two or three blows, use a puller to remove it.

(6) Remove the key (24) from the crankshaft.

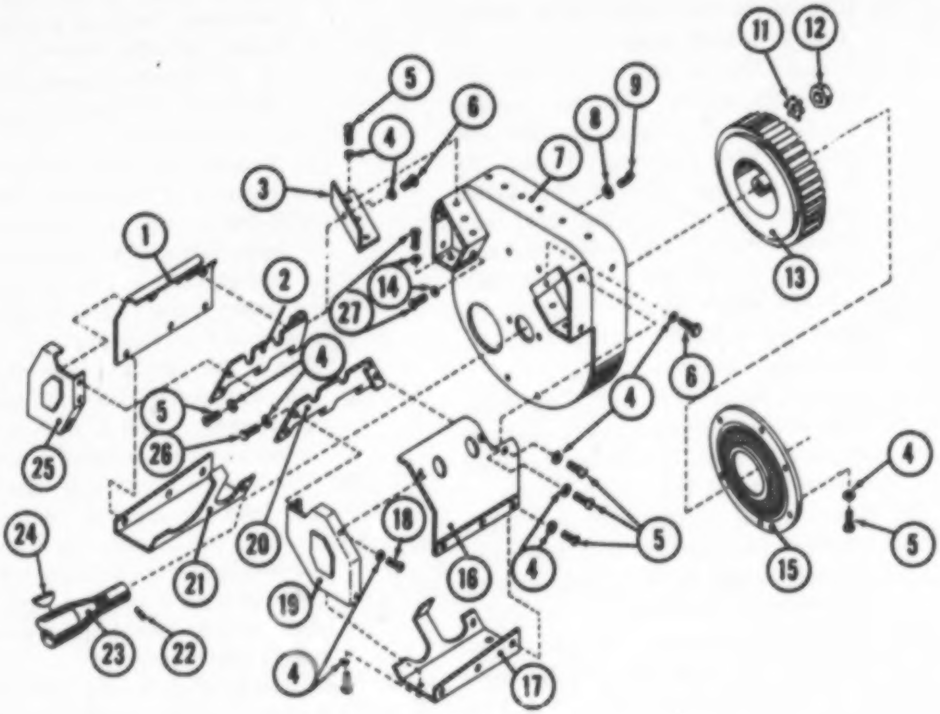
b. Cleaning and inspection.

(1) Wash all parts in an approved cleaning solvent; dry thoroughly. Use a wire brush if necessary to clean the rust and scale from the flywheel.

(2) Inspect the flywheel for cracked or broken vanes. Replace a damaged flywheel.

(3) Replace any unserviceable hardware.

c. Installation. Reverse the procedures outlined in *a* above.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1	Cylinder head shroud
2	Cylinder heat deflector
3	Side cover
4	Lockwasher
5	Machine screw
6	Cap screw
7	Flywheel shroud
8	Lockwasher
9	Cap screw
11	Flywheel mounting lockwasher
12	Flywheel mounting nut
13	Flywheel fan
14	Lockwasher
15	Flywheel screen
16	Cylinder head shroud
17	Lower cylinder shroud
18	Machine screw
19	Rear shroud cover
20	Cylinder heat deflector
21	Lower cylinder shroud
22	Crank pin
23	Crankshaft
24	Woodruff key
25	Rear shroud cover
26	Capscrew
27	Capscrew

Figure 22. Air shrouds and flywheel, exploded view.

72. Engine Air Shrouds

a. Removal.

(1) Cylinder head shrouds.

(*a*) Disconnect the spark plug cables from the spark plugs.

(*b*) Remove the 10 screws (5, fig. 22) and lockwashers (4) that secure the two spark plug cable clips and cylinder head shrouds (1 and 16) to the flywheel shroud (7), lower cylinder shrouds (17 and 21), rear shroud covers (19 and 25), and cylinder heat deflectors (2 and 20). Lift the spark plug cables, and remove the cylinder head shrouds.

(2) Rear shroud covers.

(*a*) Remove the screw, nut, and lockwasher that secure a spark plug cable clip to each of the rear shroud covers (19 and 25).

(*b*) Remove the two screws and lockwashers (4) that secure the rear shroud covers to the cylinder heat deflectors (2 and 20).

(*c*) Remove the screws (5) and lockwashers (4) that secure the lower cylinder shrouds (17 and 21) to the rear shroud covers; remove the rear shroud covers.

(3) Lower cylinder shrouds. Remove the two cap screws (27) and lockwashers (14) that secure each of the lower cylinder shrouds (17 and 21) to the flywheel shroud (7); remove the lower cylinder shrouds.

(4) Flywheel shroud.

(*a*) Remove the front panel.

(*b*) Remove the flywheel fan.

(*c*) Remove the cap screws (9) and lockwashers (8) that secure the flywheel shroud (7) to the gearcase cover; remove the flywheel shroud.

b. Cleaning and inspection.

(1) Wash the removed air shrouds with an approved cleaning solvent; dry thoroughly. Use a wire brush to remove any carbon or dirt deposits.

(2) Use a wire brush and compressed air to clean the air fins on the engine.

(3) Inspect the shrouds for cracks, breaks, or bends that would affect the circulation of air. Straighten any dented or bent areas. Replace any unserviceable parts and hardware.

c. Installation. Follow the procedures outlined in *a* above in the reverse manner.

Section XI. TRAILER WHEELS AND AXLE

73. Wheels and Tires (fig. 23)

a. General.

(1) *Tires.* The two trailer wheels (4) carry 7.00 x 16 heavy-duty tires (3) and tubes (2) inflated to 45 pounds pressure.

(2) *Wheels.* The two wheels are of the conventional drop-center type. They are 16 inches in diameter, and are equipped with inner and outer bearings with grease seals and grease caps. A standard size 7.00 x 16 tube is provided with a valve for inflating and deflating the inner tube and tire.

b. Removal.

(1) Place a hydraulic jack under the axle assembly. Raise the unit approximately 1 inch off the ground. Block up the unit with large wood blocks placed underneath the axle to prevent movement.

(2) Remove the five nuts (28) from each wheel (4), and take each wheel with with tire from the hub stud assembly (12).

c. Disassembly.

(1) Deflate the tires and tubes, and pry tires and tubes from the steel wheels.

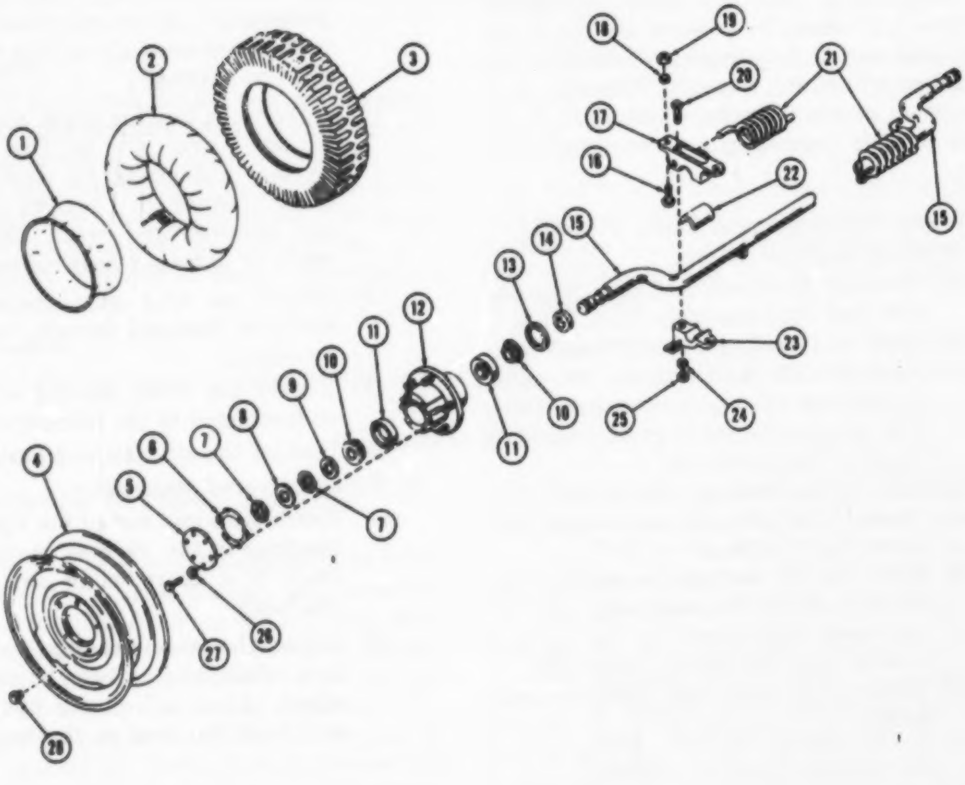
(2) Remove the inner tubes from the tires.

d. Cleaning and inspection.

(1) Clean the tires with plain water. Remove grease, dirt, and foreign matter from the wheels using a cloth dampened with an approved cleaning solvent.

(2) Remove nails, glass, or other objects that may be imbedded in the tire, using long-nosed pliers for that purpose.

(3) Inspect tires for evidence of cracks, deep sidewall cuts, or separated tire treads; replace worn or damaged tires.



1	Flap
2	Tube
3	Tire
4	Wheel
5	Cap
6	Gasket
7	Nut
8	Washer
9	Tongue washer
10	Bearing cone
11	Bearing cup
12	Hub and stud assembly
13	Oil seal
14	Collar
15	Axle
16	Bolt
17	Bracket
18	Lockwasher
19	Hex nut
20	Bolt
21	Torsion spring
22	Insert
23	Bracket
24	Lockwasher
25	Hex nut
26	Lockwasher
27	Cap screw
28	Wheel nut

Figure 23. Trailer wheel and axle parts, exploded view.

(4) Replace inner tubes that are cut or otherwise damaged.

(5) Inspect the steel wheels for bends, cracks, or other damage; repair or replace bent or damaged wheels.

e. Reassembly.

(1) Follow the instructions contained in *c* above in the reverse manner.

(2) Inflate the tires and tubes to 45 psi air pressure.

f. Installation. Carefully place the assembled tire and wheel to position on the brake drum, and secure it in position with the five nuts taken off during removal. Place the other components removed on the wheel and tire assembly in their proper position and tighten each nut.

74. Wheel Bearings and Seals (fig. 23)

a. Removal and disassembly.

(1) Remove the wheels and tires from the hub and stud assembly (par. 73*b*.).

(2) Remove the capscrews (27) and lockwashers (26), and remove the outer grease cap (5) and lockwashers (26), and remove the outer grease cap (5). Remove the gasket (6).

(3) Flatten the tang on the washer (8). Remove the nuts (7) and washer (8) from the axle (15).

(4) Slide the hub and stud assembly (12) off the end of the axle body (15), at the same time removing the tongue washer (9) and bearing cone (10).

(5) Remove the collar (14) from the axle body.

(6) Remove the oil seal (13) from the hub and stud assembly (12). Remove the inner bearing cone (10). Do not remove the bearing cones (10) unless they are damaged or worn. If worn, remove them using a brass drift or bearing puller.

b. Cleaning and inspection.

(1) Wash all parts in an approved cleaning solvent and dry with clean compressed air. Do not spin bearing cones with compressed air as this will damage the bearing.

(2) Inspect the bearing cones for pitting, excessive wear, and for free rotation. Replace a damaged or worn bearing cone. Inspect the bearing cups for pits, grooves, and wear. Replace a worn or damaged bearing cup.

(3) Inspect the axle nuts for stripped, worn, or damaged threads; replace as necessary.

(4) Repack the wheel bearing with GAA as instructed in the lubrication order.

(5) Discard the oil seals and gaskets.

c. Reassembly and installation.

(1) Reassemble and install the wheels and bearings in the reverse manner outlined in *a* above using new gaskets and seals.

(2) Adjust the wheel bearings until there is a slight bind when rotating the wheel. Slack off on the nut slightly and bend the tang on the washer.

CHAPTER 4

FIELD AND DEPOT MAINTENANCE

Section I. INTRODUCTION

75. General

Instructions in this section and in succeeding sections of this chapter are published for the use of maintenance personnel responsible for third and higher echelons of maintenance of the pump unit. They contain information on maintenance which is beyond the scope of the tools, equipment, or supplies normally available to using organizations.

76. Procedure

a. The following sections describe the complete disassembly, repair, reassembly of the centrifugal pump unit and pump engine. Before proceeding with overhaul, check to see that replacement parts are available.

b. The tools and equipment used for the repair of the centrifugal pump units and pump engines are those that are normally issued to a field and depot shop, and are not enumerated in this section.

c. Repair parts for field and depot maintenance are listed in TM 5–4320–218–35P.

Section II. ENGINE

77. Description of Engine Operating Cycle

a. General. The four-cycle engine is so termed because of the four distinct and separate strokes of the piston during one complete power cycle. The engine develops power by rapidly burning a highly compressed mixture of fuel and air in a closed combustion chamber. The ignited force of the burned fuel-air mixture is directed against the piston that compressed the gas, driving the piston away from the ignition. The piston is attached to a crankshaft, which changes the reciprocating motion of the piston to a rotary, driving motion.

b. Four-stroke action.

(1) *Intake stroke.* On the intake, or first stroke of the cycle, the piston moves downward; the exhaust valve is closed, and the intake valve is open. Fuel-air mixture is drawn into the combustion chamber by the partial vacuum created by the downward piston motion.

(2) *Compression stroke.* On the compression stroke, the piston moves upward. Both exhaust and intake valves are closed, and the upward piston motion compresses the fuel-air mixture.

(3) *Power stroke.* The power stroke starts when the compressed fuel-air mixture is ignited by a spark from the spark plug. The ignited mixture drives the piston downward against the crankshaft to which it is attached by the connecting rod. Both the exhaust and intake valves are closed during this stroke.

(4) *Exhaust stroke.* During the exhaust stroke, burned gases resulting during the power stroke are expelled from the cylinder. The exhaust valve is open, and the upward motion of the piston forces the gases through the valve opening to prepare the cylinder for the intake stroke of the next cycle.

c. Cylinder firing order. Because of the V-type construction of the engine the interval of crankshaft rotation between firing of the cylinder is as follows: 180 degrees between cylinders No. 1 and No. 3, 270 degrees between cylinders No. 3 and No. 4, 180 degrees between cylinders No. 4 and No. 2, and 90 degrees between cylinders No. 2 and No. 1

78. Engine and Pump Removal for Disassembly

Whenever it becomes necessary to remove the engine and pump assembly from its mounting on the trailer for overhaul purposes, the engine and pump assembly is removed as a unit. The pump is directly connected to the engine. The crankshaft extends into the pump and serves as an impeller shaft for the pump. Before the pump and engine can be removed certain components of the pump must be removed as follows:

a. Remove the pump suction manifold.

b. Remove the pump discharge manifold.

c. Disconnect the fuel line from the engine fuel pump to the fuel tank.

d. Disconnect the suction gage at the suction manifold.

e. Remove the nuts, bolts, and lockwashers securing the pump and engine to the trailer frame.

f. Use a lifting device such as a crane and lift off the engine and pump as an integral unit from the trailer. The unit is lifted by means of the lifting eye located in the center of the unit.

79. Engine Cleaning and Inspection After Reassembly

a. Before reinstalling the engine, be sure that the cleaning, inspection, and repair procedures for each component have been performed, following instructions contained in succeeding sections of this chapter.

b. Remove all dirt, grease, grit, and other foreign matter from the mounting surfaces.

c. Clean all the mounting screws, lockwashers, and nuts with a stiff wire brush and an approved cleaning solvent. Inspect each threaded surface for corrosion and damage.

d. Replace all mounting screws and nuts which are corroded or otherwise damaged.

80. Engine and Pump Installation After Reassembly

The engine-pump assembly can either be installed as a unit, or each assembly can be installed separately. Position each component and secure it with the attaching parts, reversing the procedure described in paragraph 78. Tighten each attached part and rotate the pump by hand cranking the engine to see that it turns freely.

Section III. FUEL PUMP

81. Description

The diaphragm-type fuel pump is mechanically operated off a cam on the engine camshaft through the fuel-pump adapter. The cam action is transmitted to the pump rocket arm which, in turn, pulls down the pump diaphragm against the pressure of the diaphragm spring, producing a vacuum in the fuel chamber. Pressure in the outlet line forces the outlet valve to close against the vacuum and pulls the inlet valve open. Atmospheric pressure in the supply tank forces fuel through the inlet into the pump fuel chamber. On the return stroke of the rocket arm, the diaphragm spring forces the diaphragm upward, the inlet valve closes, and the outlet valve opens, allowing fuel to flow through the outlet to the carburetor. The pump has an integral filter and pulsator. The pulsator is designed to minimize the flow variations experienced with a two-cycle pump stroke, and to provide increased flow characteristics up to 50 percent. Figure 9 shows the fuel pump and the adapter mounted on the engine. An exploded view of the fuel pump and adapter is shown in figure 24.

82. Fuel Pump Disassembly (fig. 24)

a. Remove the fuel pump and the fuel-pump adapter from the engine.

b. With a file, make an indicating mark across the union of the fuel head (6) and the mounting bracket (18) to aid in reassembly.

c. Remove the six screws (7) securing the head (6) to the bracket (18); remove the head.

d. Remove the bolt (1) and gasket (2) securing the pulsator dome (3) to the fuel head; remove the pulsator dome, valve, and filter screen (5).

e. Remove the three screws (14) securing the valve plate (13) and gasket (12) to the valve cover; remove the valve plate, gasket, two valves (11), two valve springs (10), and one valve spring retainer (9). Note the position of the valves in the fuel head.

f. Insert a suitable screwdriver into the coils cf the rocker-arm spring (20) and pry out the spring.

g. Hold the mounting bracket (18) in the left hand with the rocket arm (21) toward the bracket and the thumb nail on the end of the link (19); with the heel of the right hand on the diaphragm (15), compress the diaphragm spring (17) and pull the link out from the body. This will unhook the link from the diaphragm push rod. Remove the diaphragm and the diaphragm spring.

h. Drive out the rocker-arm pin (34), releasing the link (19) and rocker arm (21).

i. Unscrew the priming handle (26) and remove the spring (27) and shaft (29) from the adapter (30).

j. Place the plunger (32) in a suitable vise and carefully pry up on the cap (23). Make sure that the jaws on the vise do not damage the plunger.

83. Fuel Pump Cleaning and Inspection

a. Clean all the metal parts removed in an approved cleaning solvent. Dry thoroughly.

b. Inspect the filter screen for tears and replace it if it is torn or damaged.

c. Examine the bracket and the fuel head assembly for cracks or breaks; replace if necessary.

d. Inspect the priming handle spring for signs of corrosion or other damage. Replace the spring if it is bent or worn.

e. Examine the diaphragm flange for warpage. If the flange is warped more than 0.010 inch, replace the diaphragm. If the warpage is less than 0.010 inch, flatten the flange with the use of a suitable grinder.

f. Insert the plunger (32) in the adapter and measure the plunger-to-adapter clearance. If the clearance exceeds 0.0045 inch, check the diameter of the plunger shaft and replace the shaft if it measures less than 0.3712. Replace the adapter if the inside diameter has worn to a dimension that exceeds 0.376.

g. Replace any worn gaskets, springs, or other damaged parts.

84. Fuel Pump Reassembly

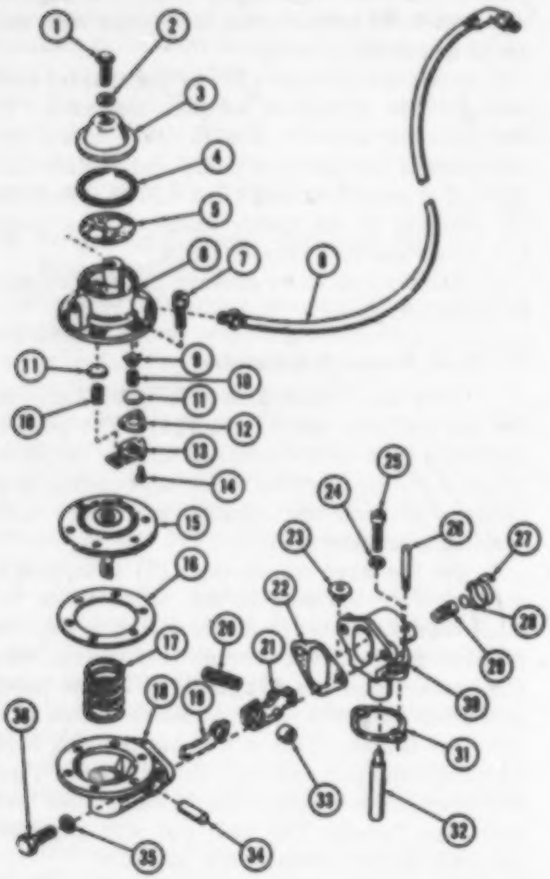
a. Slide the rocker-arm link (19) between the jaws of the rocket arm (21). The correct position of the rocket arm can usually be determined by matching the rocker-arm spring projections of both the rocker arm (21) and mounting bracket (18).

b. Set the large coil spring (17) (diaphragm spring) over the seat in the body. Place the diaphragm assembly over this spring so that the pull rod points down through this spring. Hold the bracket and diaphragm (16) in one hand, and pinch the knob on the rocker-arm link (19) with the thumb. This will bring the link hook up where the pull rod can reach it easily. Push the diaphragm down while holding the link with the thumb. The pull rod will slip over the link easily. Release the pressure.

c. Set the rocker-arm spring (20) in position. One end fits over the small cone cast into the body. The other end can be snapped over the small projection of the rocker arm. Lay the bracket on its side and insert the rocker-arm pin (34) in the hole in the bracket (18).

d. Drop the fiber valve seat down into the inlet-valve pocket. Then place one of the valve springs over it. Drop the outlet-valve retainer down into the valve hole. Then place the spring over the retainer and the outlet valve on top of the spring. Put the retainer gasket in position and place the valve retainer down on the valves so that the small holes in the retainer line up with the screw holes in the casting.

Note. This retainer is slightly curved or "bowed." Install it so the hump of the curve faces upward. This will give the retainer some spring pressure when the screws are tightened. Tighten the retainer screws securely.



1	Dome bolt
2	Gasket
3	Dome
4	Gasket
5	Filter screen
6	Fuel head
7	Screw
8	Fuel line
9	Spring retainer
10	Valve spring
11	Valve
12	Gasket
13	Valve plate
14	Screw
15	Diaphragm
16	Gasket
17	Spring
18	Bracket
19	Linkage
20	Spring
21	Rocker arm
22	Gasket
23	Plunger cap
24	Lockwasher
25	Cap screw
26	Primer handle
27	Spring
28	Packing ring
29	Primer shaft
30	Adapter
31	Gasket
32	Plunger
33	Bushing
34	Pin
35	Lockwasher
36	Capscrew

Figure 24. Fuel pump and adapter, exploded view.

e. Clean the fine mesh screen thoroughly in an approved cleaning solvent and wipe dry. Be careful not to bend or damage it. Set the cork cover-plate gasket on the edge of the body casting. Place the screen (5) over the gasket in such a way that the rim of the screen lies close against it. The two small metal projections near the center of the screen should face upward. Replace the pulsator dome.

Warning: **Be sure to thoroughly clean the inside of the bowl and cover. Lay the cover over the casting and screen, and replace the cap screw through the hole in the center of the cover. Tighten this screw securely. Be sure the fiber gasket is in place on the cap screw.**

f. Put the pump bracket in a vise. Line up the file mark on the edge of the bracket with the file mark on the edge of the fuel head. Get the diaphragm flush by moving the rocker arm, and hold it flush while installing all the screws and lockwashers. Be sure that the screws pass through the holes in the diaphragm easily without damaging the fabric. Tighten them evenly and securely. Push the rocker arm back and forth several strokes, releasing it with a snap. The pump is now fully assembled and ready for service.

g. Install the fuel pump and the fuel pump adapter in place on the engine. Start the engine and observe the operation of the fuel pump. Check for leaks; tighten any loose connections.

Section IV. CARBURETOR

85. Description

The carburetor is a horizontal, single-venturi type with a straight-through air intake. The float chamber is constructed concentric with the main discharge jet, thereby practically surrounding the main metering system with fuel. This design permits a supply of gasoline to be present at the main discharge jet, even when the engine is at an angle. The float assembly is of the dual type and is so constructed that one float operates in each side of the float chamber. The dual floats are connected to the float needle valve by a single lever.

86. Carburetor Disassembly (fig. 25)

a. Remove the carburetor from the engine.

b. Loosen the screw (16) and screw (20) and disconnect the choke control (25) from choke swivel (17).

c. Invert the carburetor body (9) with the fuel bowl (30) facing up. Remove the bowl retaining plug (31) and gasket (26). Remove the bowl (30) and gasket (29).

d. Remove the float lever shaft (24) and lift off the float (28). Lift out the valve (27) from its seat.

e. Use a screwdriver of the proper size and remove the valve seat (27) and gasket (26). Remove the main nozzle (32) and gasket (33).

f. Turn the choke shaft until the screws (19) can be removed. Remove the screws (19) and pull out the choke fly (18) and choke shaft (14) from the body (9). Remove the screws (20 and 12) and remove the choke bracket assembly (21).

g. Remove the screws (1) and remove the throttle fly (2). Slide the throttle shaft assembly (5) from the body (9).

87. Carburetor Cleaning and Inspection

a. Clean all the metal parts in an approved cleaning solvent and dry each part thoroughly.

b. Blow out all passages in the throttle body and fuel bowl with clean, dry compressed air. Reverse the flow of air in the passages to insure that all dirt has been removed. Make sure that all carbon deposits and other foreign matter have been removed from the throttle bore and idle port.

Note. Do not use a wire or drill to clean out the jets.

c. Inspect the top side of the float for wear where it contacts the fuel-valve needle. Replace the float if it is loaded with fuel or damaged, if its axle bearing is worn, or if its top surface shows wear.

d. Replace the float axle if it is visibly worn or bent.

e. Examine the idle adjusting needle, and replace it if its point is rough or damaged.

f. Inspect the throttle plate and the choke plate; replace if rough or if the edges are damaged.

g. Check the bearing surfaces of the choke shaft and throttle shaft for wear; replace if worn.

h. Whenever the carburetor is disassembled, replace the fuel valve and seat and all gaskets and fiber washers.

i. Rebush the carburetor body to provide a close fit for the throttle shaft, as follows:

(1) Place a suitable center in the drill press bed. With one throttle-shaft hole on this center, bring the spindle down until the counterbore reamer contacts the opposite shaft hole. The reamer provides a press fit for the

outside diameter of the throttle-shaft bushing.

(2) With the casting still in place, set the stop on the press to the length of the bushing. This will give the approximate setting of the spindle travel.

(3) Counterbore the hole to accommodate the bushing.

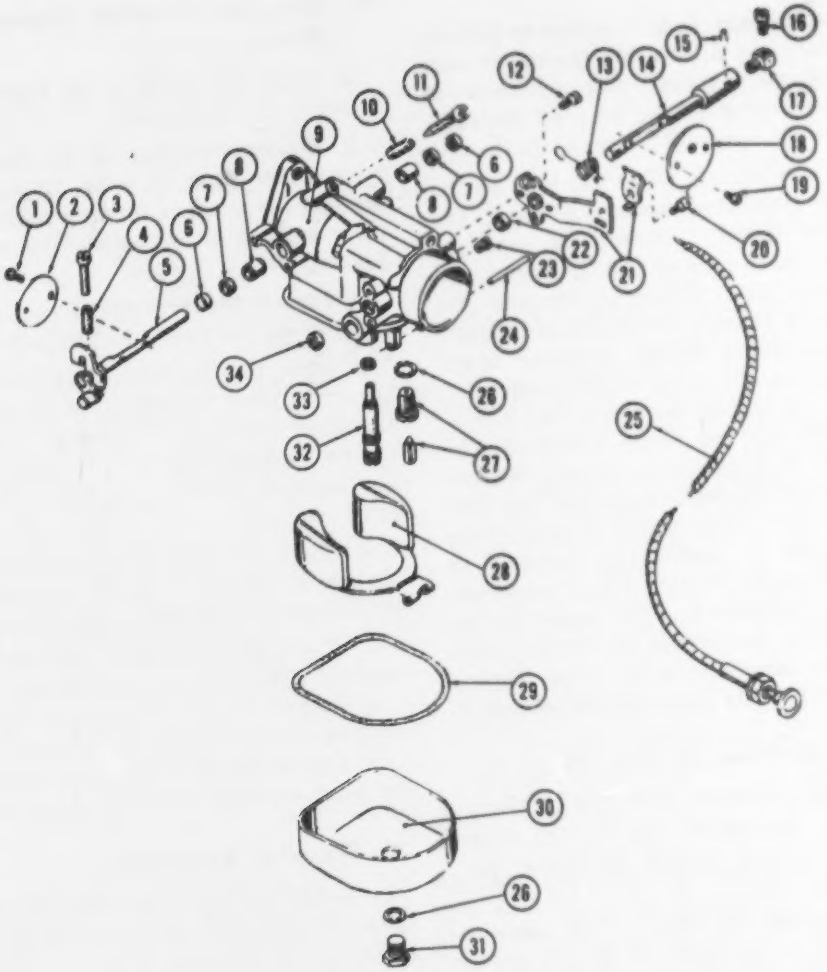
(4) Drive the throttle-shaft bushing into place, using the proper bushing driver.

(5) Ream this bushing with the line reamer, using the opposite shaft hole as a pilot to aline the line reamer in the bushing.

(6) Turn the casting over and prepare the opposite hole to take the bushing. It will be necessary to reset the stops on the spindle. Counterbore the hole and drive the second throttle-shaft bushing into position. Line-ream the inside diameter as before.

88. Carburetor Reassembly

Reassemble the carburetor in the reverse manner outlined in paragraph 86.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1 Screw
2 Throttle fly
3 Throttle stop screw
4 Spring
5 Throttle shaft
6 Packing retainer
7 Packing
8 Bushing
9 Body
10 Spring
11 Idle adjusting needle
12 Screw
13 Spring
14 Choke shaft
15 Cotter pin
16 Screw
17 Choke swivel
18 Choke fly
19 Screw
20 Screw
21 Choke bracket
22 Packing
23 Power jet
24 Float lever shaft
25 Choke control
26 Gasket
27 Float valve seat
28 Float and lever
29 Gasket
30 Fuel bowl
31 Plug
32 Main nozzle
33 Main nozzle gasket
34 Choke shaft cup

Figure 25. Carburetor, exploded view.

Section V. GOVERNOR

89. Description

a. The centrifugal flyball governor rotates on a stationary pin driven into the upper part of the timing-gear cover. The governor is driven through the governor gear off the camshaft gear at the speed of the crankshaft.

b. The flyweights are hinged to lugs on the gear. As the crankshaft speed increases, the flyweights are thrown outward by centrifugal force. Hardened pins on the flyweights are brought to bear on a sliding sleeve, and the movement of the sleeve is transmitted through a ball thrust bearing to the governor lever, which, in turn, is connected to the carburetor throttle lever. A spring hooked to the governor lever tends to hold the governor flyweights in and to hold the carburetor throttle open. As the engine speed increases, the centrifugal force of the flyweights acts against the spring and closes the carburetor throttle to maintain a practically constant engine speed under varying load conditions. This speed can be varied by hooking the spring in various holes provided in the governor lever. (See figure 13). (See par. 57*b* for governor adjustment).

90. Governor Disassembly (fig. 26)

a. Remove the governor from the engine.

b. Slide the assembled gear (19) and thrust sleeve (11) and bearing (9) out of the governor housing (4).

c. Spread the two flyweights (14) on the flyweight hub (18) and slide the thrust sleeve (11) and bearing (9) off the shaft (12).

d. Using a driftpin, drive out the two pins (15) that secure the flyweights to the flyweight hub (18).

e. Support the governor housing (4) on its face, and, entering the housing through the pipe fitting hole in the rear, use a driftpin to drive out the pin (7) that secures the yoke (8) to the cross shaft and lever (24). Pull out the cross shaft and lever, and remove the yoke from the governor [illegible]

f. Slid[illegible] from the cross shaft and lever (24).

g. Tap the expansion plug (5) out of the governor housing.

91. Governor Cleaning, Inspection, and Repair

a. Wash the parts in an approved cleaning solvent; dry thoroughly.

b. Examine the face of the thrust sleeve and bearing for signs of wear. Examine the bearing end for worn or binding bearing balls. Replace a worn or defective thrust sleeve and bearing.

c. Inspect the governor drive shaft for scoring or wear; replace a defective thrust.

d. Slide the assembled gear and bushing on the drive shaft and check for loose fit. A sliding fit of 0.0015 inch is proper. Check the face of the bushing for wear through contact with the bushing washer; replace a worn or damaged bushing.

e. Check the ends of the hardened pins on the flyweights for wear or roughness; replace both flyweights if either is defective.

f. Check the yoke and bushing washer for signs of wear, replace a worn yoke.

g. Inspect the governor gear for cracked or chipped teeth; replace a defective gear.

h. Inspect the hardware and remaining parts for good condition; replace them as necessary.

92. Governor Reassembly

a. Install the "O" ring seal (23) in the governor housing (4); start the cross shaft and lever into the housing.

b. Slip the yoke (8) on the cross shaft (24) and finish pressing the shaft into the housing.

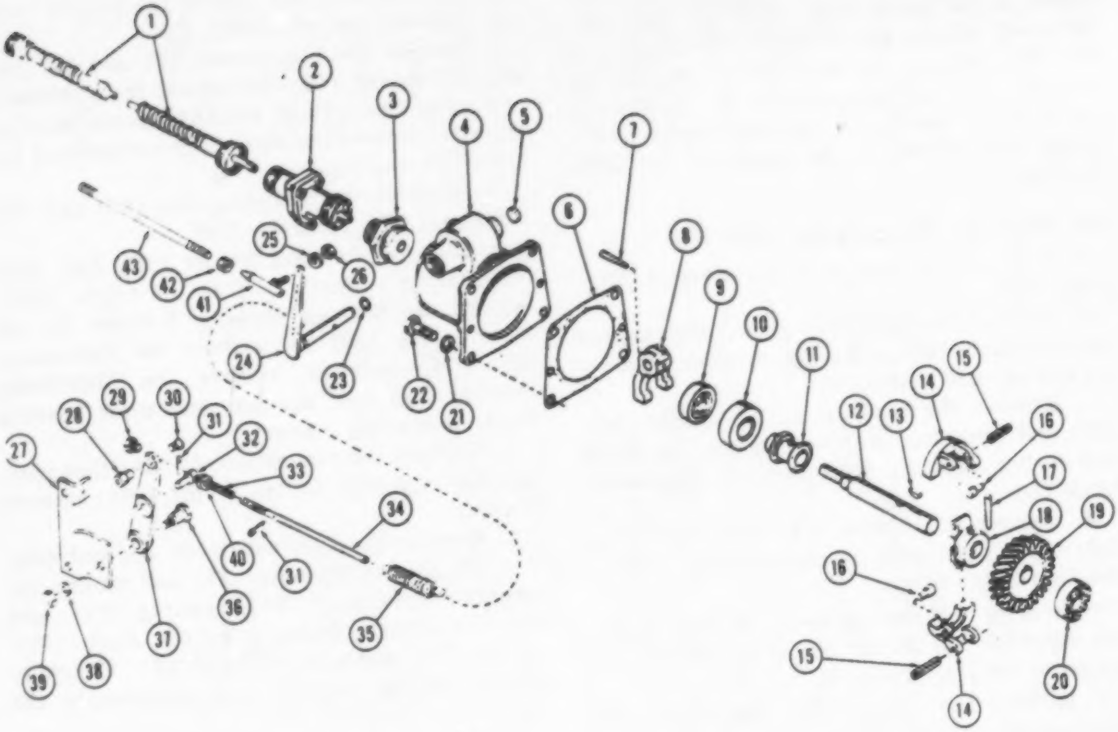
c. Aline the pin hole in the yoke (8) with that in the cross shaft (24); install the taper pin (7).

d. Position the flyweights (14) on the flyweight hub (18), and secure them with the pins (15).

e. Lift up on the flyweights, and slip the thrust sleeve (11) and bearing (9) on the drive shaft (12).

f. Install the fittings in the governor housing, and install the governor.

g. Adjust the governor (par. 57*b*). Check the speed of the engine with a tachometer. The speed should be 1800 rpm under load.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1	Flexible shaft
2	Drive joint
3	Adapter
4	Housing
5	Expansion plug
6	Gasket
7	Taper pin
8	Yoke
9	Ball bearing
10	Ball bearing
11	Thrust sleeve
12	Drive shaft
13	Woodruff key
14	Flyweight
15	Pin
16	Pin
17	Taper pin
18	Hub
19	Gear
20	Ball bearing
21	Lockwasher
22	Cap screw
23	"O" ring
24	Cross shaft
25	Lockwasher
26	Nut
27	Support bracket
28	Swivel block
29	Locknut
30	Screw
31	Cotter pin
32	Swivel pin
33	Shock spring
34	Adjusting screw
35	Spring
36	Fulcrum screw
37	Fulcrum lever
38	Lockwasher
39	Hex nut
40	Spring retainer
41	Ball joint
42	Nut
43	Control rod

Figure 26. Governor, exploded view.

Section VI. MAGNETO

93. Description

The magneto is designed to produce and distribute, to the spark plugs, correctly timed electric spark discharges of sufficient intensity to fire the cylinders of the engine. An impulse coupling automatically retards the timing of the ignition sparks to prevent engine backfiring, and intensifies the spark to facilitate starting.

94. Magneto Disassembly (fig. 27)

a. Remove the magneto as described in paragraph 66*b*.

b. Remove the screws (7 and 8) that secure the end cap (73) to the frame (39); remove the end cap and gasket (69).

c. Remove the assembled high-tension lead (20) and insulator (19) and remove the brush and spring assembly (65) from the distributor block (66).

d. Remove the screws (18) that secure the distributor block (66) to the end cap; remove the distributor block.

e. Remove the two screws (4) that secure the capacitor (5) to the end cap; remove the capacitor and "O" ring (6).

f. Remove the screws (72) that secure the vent covers (71) to the end cap; remove the vent covers and screens (70).

g. Loosen the ground switch nut (79) and remove the ground switch assembly from the end cap. Remove the retaining ring (76) and disassemble the switch parts.

h. Remove the screw (17), nut (12), lockwasher (11), and plain washer (10) that hold the ground strip guide (13), capacitor contact (14), ground switch lead (15), and insulator bushing (16) to the end cap; disassemble the parts.

i. Remove the screw (17), nut (75). and lockwasher (74) that hold the ground switch to contact support and the contact support strap (67) to push button strap (68) to the end cap; remove the parts.

j. Remove the distributor rotor (21).

k. Remove the screw (58) that secures the coil lead and the spring of the contact arm (25) to the stationary contact. Remove the retaining ring (24) and remove the contact arm and breaker arm wick (64).

l. Remove the two screws (60 and 63) and the flat washer (62) that secure the stationary contact of the contact set (61) to the bearing support; remove the stationary contact and the cam wick and holder.

m. Remove the retaining ring (26) and the rotor gear (27) from the rotor.

n. Remove the four screws (28) that hold the bearing support (29) to the frame (39); remove the bearing support. Remove the retaining ring (30) and remove the distributor gear. If damaged, remove the distributor bearing (23) and the cam end rotor bearing from the bearing support.

o. Remove the two setscrews (38) that position the coil (57) in the frame (39); remove the coil.

p. Remove the lock wire (50) and nut (49) from the end of the rotor (33) and remove the magneto drive gear (51), bushing (52), and the assembled impulse coupling shell (53), spring (54), and hub assembly (55). Carefully release spring tension and disassemble the parts.

q. Remove the oil slinger (45), outer seal washer (44), seal (43), and inner seal washer (42) from the end of the rotor.

r. Remove the retaining ring (41) and tap the rotor from the frame.

s. Remove the retaining ring (35) and remove the shim (36) and bearing (37) from the frame.

t. Remove the screws (48) that secure the vent cover (47) and screen (46) to the frame; remove the parts.

95. Magneto Cleaning, Inspection and Repairs

a. Wash all metal parts in an approved cleaning solvent, except the capacitor, coil, bearings, and breaker contacts. Dry all parts with clean compressed air.

b. Inspect the vent screens for damage or clogging. If necessary, blow the screens clean with compressed air.

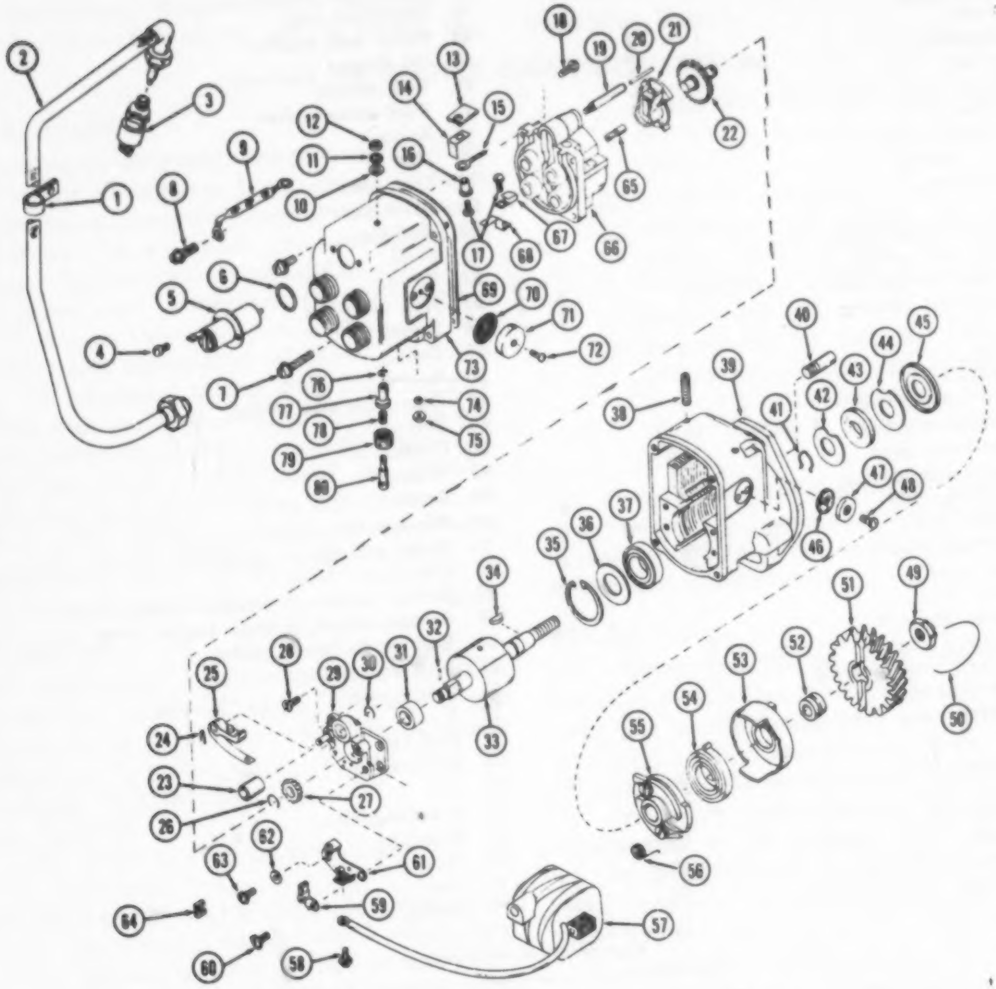
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Figure 27. Magneto, spark plug and cables, exploded view.

1 Wire clip
2 Cable assembly
3 Spark plug
4 Screw
5 Capacitor
6 O-ring
7 Screw
8 Screw
9 Ground strap
10 Flat washer
11 Lockwasher
12 Nut
13 Ground strip guide
14 Capacitor contact
15 Ground switch lead
16 Insulating bushing
17 Screw
18 Screw
19 Insulator
20 High tension lead
21 Distributor rotor
22 Distributor gear
23 Distributor bearing
24 Retaining ring
25 Contact arm
26 Retaining ring
27 Rotor gear
28 Screw
29 Bearing support
30 Retaining ring
31 Cam end rotor bearing
32 Rotor gear pin
33 Magnetic rotor
34 Key
35 Retaining ring
36 Shim
37 Bearing
38 Setscrew
39 Frame
40 Stop pin
41 Retaining ring
42 Inner seal washer
43 Drive end seal
44 Outer seal washer
45 Oil slinger
46 Vent screen
47 Vent screen cover
48 Screw
49 Nut
50 Lock wire
51 Drive gear
52 Bushing
53 Shell
54 Spring
55 Hub assembly
56 Spring
57 Coil
58 Screw
59 Cam wick and holder
60 Screw
61 Contact set
62 Washer
63 Screw
64 Breaker arm wick
65 Brush and spring assembly
66 Distributor block
67 Ground switch to contact support strap
68 Ground switch to push button strap
69 End cap-to-frame gasket
70 Vent screen
71 Vent cover
72 Screw
73 End cap
74 Lockwasher
75 Nut
76 Retaining ring
77 Bushing
78 Spring
79 Nut
80 Button

Figure 27—Continued

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c. Inspect the distributor block for breaks, cracks, carbon tracking, burned electrodes, and worn or damaged brush. Replace all defective parts.

d. Replace the distributor rotor if broken, cracked, oil soaked, or if the contact surface is burned, pitted, or chipped.

e. Place the capacitor on a tester and test it for capacity, series resistance, and leakage resistance. The capacitor must be between 0.17 to 0.22 mfd (microfarads). The series resistance must not exceed 0.4 ohm. The leakage resistance must be not less than 50,000 ohms. Replace a faulty condenser.

f. Replace the breaker arm and stationary contact set. Replace these parts as sets only.

g. Check the tension of the breaker arm spring. The correct tension is from 15 to 30 ounces.

h. Inspect the bearings for cracks, scoring, flaws, wear, and/or other damage. Replace damaged parts.

i. Replace the rotor if the shaft journals are worn or pitted.

j. Inspect the drive spring and pawl springs for corrosion, bends, and metal fatigue. Replace defective parts.

96. Magneto Reassembly and Installation

a. Reassembly. Reassemble the magneto by referring to paragraph 94 and reversing the procedure.

b. Installation. Refer to paragraph 66*d* for installation details.

Section VII. ENGINE LUBRICATION SYSTEM

97. Description

A gear-type oil pump, driven from the idler gear in the timing-gear train, draws oil from the crankcase oil sump through its filter screen. It delivers the oil under pressure to an oil header, which sprays oil against fins of the connecting-rod caps to lubricate the rod bearing, and directs oil through exterior oil lines to the governor and bypass-type oil filter. The cylinders are lubricated by the mist from the connecting rods and crankshaft. Lubrication and splash plates are installed inside the crankcase to prevent excess lubrication of the cylinder walls. The lubrication system is protected from dirt or other foreign matter by a screen over the intake of the oil pump, and by the oil filter.

98. Oil Pan

a. Description. The bottom cover plate (32, fig. 28) is also the oil pan of the engine and also serves as an oil reservoir. The oil pan is provided with a pipe nipple (34) to drain the crankcase oil from the engine.

b. Removal.

(1) Drain all the crankcase oil from the engine.

(2) Lay the engine on its side, supporting it in such a manner which will prevent damaging the cylinder air shrouds.

(3) Remove the four cap screws (39) and lockwashers (40) that secure the front and rear engine supports (44) to the bottom of the crankcase; remove the engine supports.

(4) Remove the fourteen cap screws (33) and lockwashers (9) that secure the crankcase bottom cover plate (32) to the crankcase (6); remove the cover plate and gasket (31).

(5) Remove the slotted pipe plug and the Allenhead setscrew located beneath the pump in the crankcase.

c. Cleaning inspection.

(1) Scrape out all sludge and foreign particles accumulated on the bottom of the oil pan, and wash all parts removed in an approved cleaning solvent.

(2) Brush the screen with a stiff brush and remove all sludge and foreign matter from between the wires of the screen. Dry with clean, dry compressed air.

(3) Inspect the oil pan for dents. If minor, smooth out with hammer and a wood block. Replace the oil pan if it is damaged beyond serviceable limits.

d. Installation. Apply a thin coat of grease on a new oil-pan gasket and install the oil pan in place on the crankcase with the fourteen cap screws and lockwashers.

99. Oil Pump

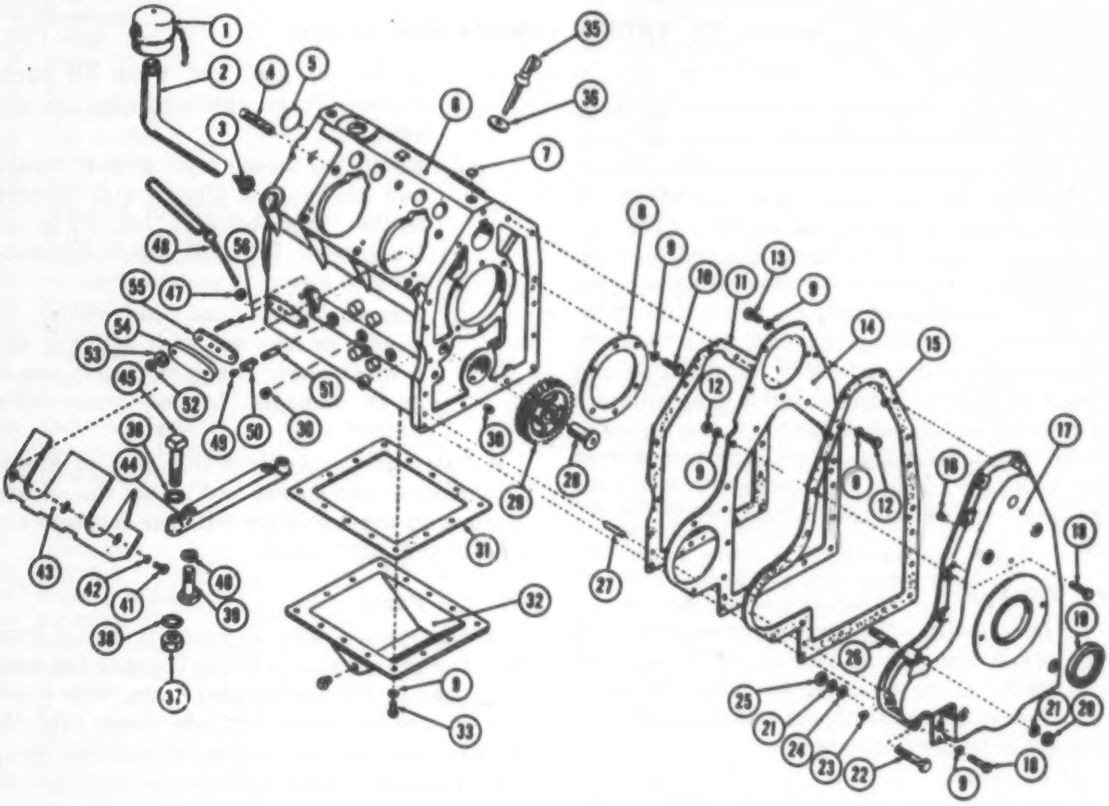
a. Description. The oil pump is driven from the idler gear, which is located next to the magneto gear in the timing-gear train. The lower end of the oil pump extends down into the oil pan, and the oil is drawn into the pump for circulation under pressure to lubricate the components of the engine. When the engine of the pumping unit is operating under normal condition, oil pressure will be approximately 5 psi.

b. Removal.

(1) Remove the oil pan as instructed in paragraph 98.

(2) Remove the ten cap screws (18, fig. 28) and lockwashers (9) that secure the gear cover to the crankcase. Using a suitable driftpin, carefully drive the two dowel pins (27) out from the gear cover; remove the gear cover and the gear-cover gaskets (15) from the engine and press the oil seal (19) out of the gear cover.

(3) Remove the two cap screws (13) and the lockwashers (9) that secure the gear-cover spacer (14) to the gear cover (17).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1	Breather cap	8	Plate	15	Gasket	22	Cap screw
2	Tube	9	Lockwasher	16	Button	23	Pipe plug
3	Screen	10	Cap screw	17	Gear cover	24	Plain washer
4	Stud	11	Gasket	18	Cap screw	25	Hex nut
5	Expansion plug	12	Hex nut	19	Seal	26	Stud
6	Crankcase	13	Cap screw	20	Hex nut	27	Dowel pin
7	Expansion plug	14	Gear cover spacer	21	Lockwasher	28	Idler gear stud

Figure 28. Engine block, bottom cover plate and gear cover plate, exploded view.

29 Idler gear
30 Pipe plug
31 Gasket
32 Plate
33 Cap screw
34 Pipe plug
35 Short oil sabre
36 Cork washer
37 Hex nut
38 Lockwasher
39 Cap screw
40 Lockwasher
41 Cap screw
42 Lockwasher
43 Plate
44 Engine support
45 Capscrew
46 Setscrew
47 Cork washer
48 Oil sabre
49 Plug pipe
50 Pipe tee
51 Pipe nipple
52 Nut
53 Lockwasher
54 Cover plate
55 Gasket
56 Stud

Figure 28—Continued

(4) Remove the Allen-head setscrew that was exposed when the slotted pipe plug was removed.

(5) Remove the nut (1, fig. 29) that secures the gear (2) to the oil-pump drive shaft (5). Place a suitable brass rod or a similar punch against the drive shaft, and carefully drive the shaft through the gear. The oil pump assembly can then be removed by withdrawing it toward the center of the crankcase. During removal, the pump must be protected from dropping into the crankcase.

c. *Disassembly.*

(1) Remove the cotter pin (9) and remove the spring (11) and check ball (10) from the cover (8).

(2) Remove the screw (14) and lockwasher (12); remove the screen (16) from the cover.

(3) Remove the screws (13 and 15), and remove the cover (8) and gasket (7) from the oil-pump body (3).

(4) Remove the Woodruff key (4) from the drive shaft (5), and push the shaft and gear assembly out through the rear of the oil-pump body. Lift the driven gear (18) off the stub shaft (19).

d. *Cleaning, inspection, and repair.*

(1) Wash all of the parts in an approved cleaning solvent; dry thoroughly. Use a fiber brush to clean the screen.

(2) Examine the gears for cracked, chipped, or worn teeth. Replace a defective gear. If the driver gear is to be replaced, support the gear and drive out the pin that secures the gear to the shaft. Press the shaft from the gear, press on a new gear, and install the pin.

(3) Examine the pump body and cover for cracks or breaks, and replace if defective.

(4) Test the fit of the idler gear on the idler gear shaft. The gear should turn freely but should have no perceptible wobble. If the gear wobbles, measure the gear bore and shaft diameter. The diameter of the drive shaft should be between 0.4993 and 0.5002 inch. The diameter of the shaft bore in the pump body should be between 0.498 and 0.5017 inch. There should be a bore-to-shaft clearance of between 0.003 and 0.0027 inch. The diameter of the driver gear stub shaft should be between 0.4993 and 0.5002 inch. The diameter of the bore in the driver gear must be between 0.5003 and 0.5017 inch. Replace any part that is worn beyond the limits specified above.

(5) Measure the diameter of the drive shaft and the pump body. Replace either item if worn beyond the limits cited in *d* above.

(6) Check the keyway in the drive shaft and drive gear. Repair any burred keyways, or replace the shaft if necessary.

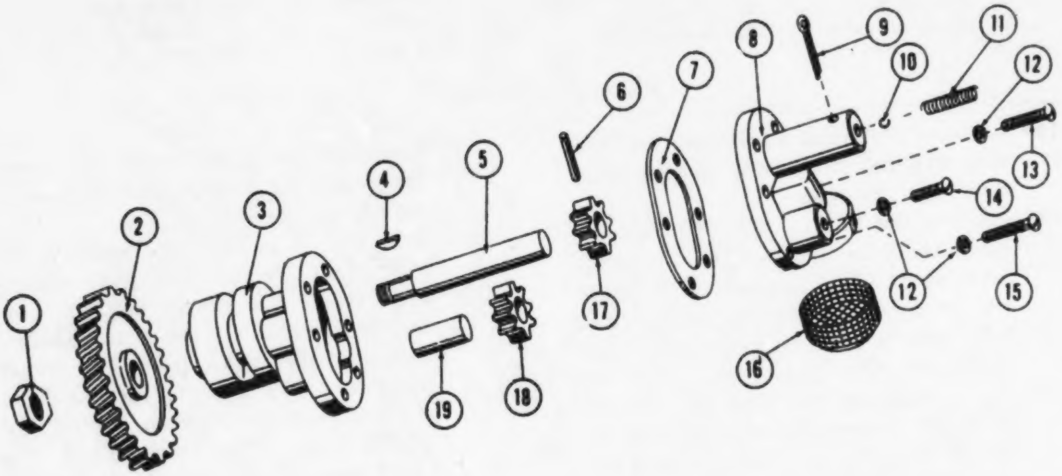
(7) Examine the screen for enlarged openings or tears. Replace if necessary.

(8) Inspect the check ball and its seat in the cover for roughness. Replace the cover or ball if necessary.

(9) Inspect the valve spring for pitting, and replace if necessary.

(10) Examine the machine screw for crossed threads. Replace if necessary.

(11) Examine the bottom cover for cracks or dents. Repair or replace the cover as necessary.



1	Nut
2	Gear
3	Body
4	Woodruff key
5	Drive shaft
6	Pin
7	Cover gasket
8	Cover
9	Cotter pin
10	Steel ball
11	Relief valve spring
12	Lockwasher
13	Screw
14	Screw
15	Screw
16	Screen
17	Driver gear
18	Driven gear
19	Stub shaft

Figure 29. Oil pump, exploded view.

e. Reassembly.

(1) Insert the assembled drive shaft (5) into the pump body (3). Install the idler gear (18) on the shaft (19).

(2) Position the gasket (7) and cover (8) on the pump body; secure the cover with the lockwashers (12) and machine screws (13 and 15).

(3) Lubricate and insert the check ball (10) and valve spring (11) into the valve bore of the cover. Compress the spring and install the cotter pin (9).

(4) Position the screen (16) on the cover, and secure with a machine screw (14) and lockwasher (12).

(5) Install the woodruff key (4) in the oil-pump shaft.

f. Installation.

(1) Install the oil pump in the crankcase with the screen facing toward the bottom of the engine. Secure with the setscrew and pipe plug.

(2) Install the gear (2) and secure with the nut (1).

(3) Apply a thin coat of grease to a new cover plate gasket (15, fig. 28) and position the gear cover (17) on the crankcase; secure with the cap screws (18) and lockwashers (9). Tighten to within 6–9 foot-pounds torque.

(4) Install the oil seal (19.

Section VIII. CYLINDER HEADS AND VALVES

100. Description

Each of the two L-type cylinder heads is secured to the cylinder blocks with 17 cap screws and plain washers. They must be removed if it is necessary to regrind the valves or to do work on the pistons and connecting rods. The valves are roto type valves, and can be adjusted by removing the valve cover plate.

101. Cylinder Heads

a. Removal.

(1) Remove the cylinder head shrouds and rear shroud covers (par. 72).

(2) Remove the manifold.

(3) Remove the spark plugs.

(4) Remove the 17 capscrews (13 and 16, fig. 30) and washers (12) that secure each cylinder head (11) to the cylinder blocks (7); remove the cylinder heads and gaskets (10).

b. Cleaning and inspection.

(1) Carefully scrape and wire brush all carbon deposists from the cylinder blocks. Clean the carbon from the tops of the pistons and blow away the carbon with compressed air.

(2) Wire brush and scrape the carbon out of the cylinder heads.

(3) Wipe the cylinder heads and blocks with a cloth dampened with an approved cleaning solvent; dry thoroughly.

(4) Inspect the cylinder heads for cracks, breaks, or warping; replace a defective cylinder head.

(5) Inspect the top of the cylinder block for cracks or breaks. Inspect the cylinder walls for scoring and pitting.

(6) Inspect the top of the valves and valve seats. Repair or replace any defective valves (see appropriate section in this manual for detailed instructions.

c. Installation.

(1) Install the cylinder heads in the reverse manner outlined in a above.

(2) Apply a mixture of graphite and oil on the cap screws and tighten to 25-32 foot-pounds torque in the sequence shown in figure 31.

102. Valves

a. General. The valves are lifted by mushroom head tappets located in the crankcase. The tappets are raised by the lobes of the camshaft, and cannot be replaced without removing the camshaft. The firing order of the cylinders is 1-3-4-2. Number 1 cylinder is the nearest one to the flywheel in the left bank of cylinders; number 3 cylinder is the other one in this bank. Number 2 cylinder is the nearest one to the flywheel in the right bank of cylinders and number 4 is the other.

b. Tappet clearance adjustment.

(1) Make sure engine is cold. Remove the cap screws (1, fig. 30) and washers (2) that secure the valve covers (3) to the cylinder blocks (7); remove the valve covers and gaskets (4).

(2) Remove the flywheel screen.

(3) Remove the spark plug from the No. 1 cylinder.

(4) Crank the engine slowly until the piston rising in the compression stroke blows air out of the spark plug hole. Continue cranking until the marked vane on the flywheel alines with the No. 1 centerline mark on on the flywheel shroud which is 45 degrees counterclockwise from the vertical as shown in figure 19.

(5) Adjust the exhaust valve tappet clearance to .016 inch. Adjust the inlet valve tappet clearance to .008 inch.

(6) Turn the engine crankshaft 180 degrees clockwise, and adjust tappet clearance on the No. 3 cylinder.

Note. Chalk mark the vane directly opposite the marked vanes on the flywheel. To determine the 180-degree turn mentioned in (6) above, turn the crankshaft until the chalk marked vane is alined with the No. 1 cylinder centerline.

(7) Turn the crankshaft clockwise until the marked vane is alined with the

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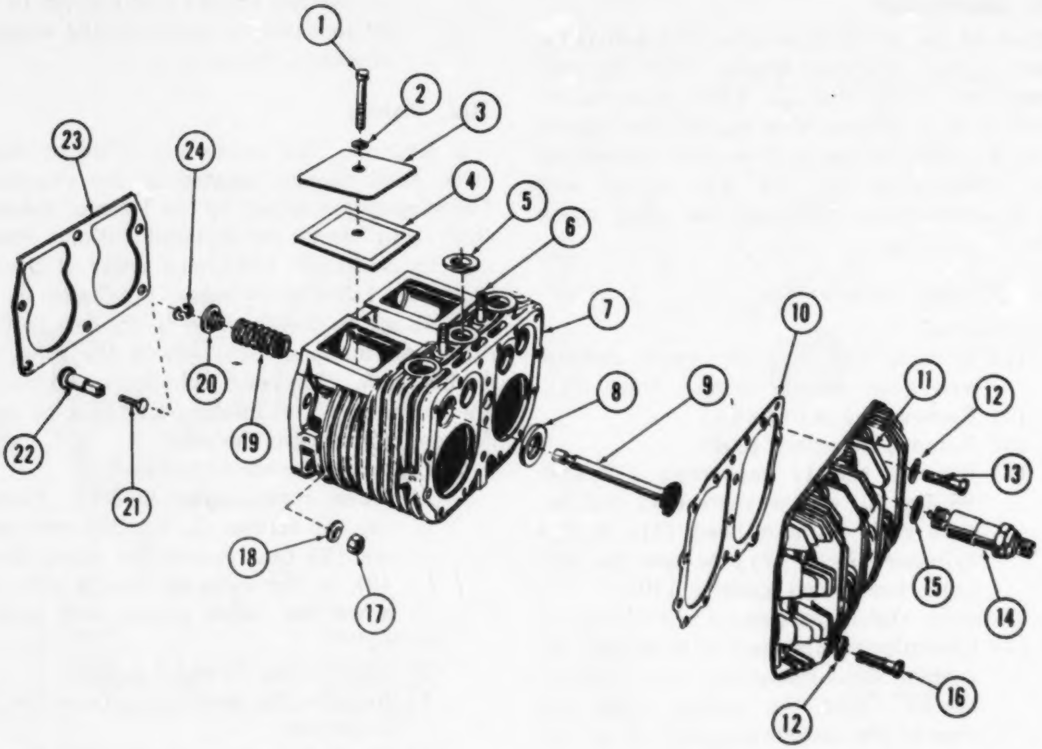


1 Cap screw
2 Plain washer
3 Valve cover
4 Cover gasket
5 Inlet-exhaust port gasket
6 Lower manifold mounting stud
7 Cylinder block
8 Valve seat insert
9 Valve
10 Cylinder head gasket
11 Cylinder head
12 Plain washer
13 Cap screw
14 Spark plug
15 Spark plug gasket
16 Cap screw
17 Nut
18 Lockwasher
19 Valve spring
20 Valve spring seat
21 Adjusting screw
22 Tappet
23 Cylinder block gasket
24 Valve spring seat lock

Figure 30. Cylinder block, valves, and cylinder head, exploded view.

No. 2 cylinder centerline which is 45 degrees clockwise from the vertical. This position is 270 degrees past the position of (6) above. Adjust the tappet clearance of No. 4 cylinder.

(8) Turn the crankshaft until the chalk marked vane is alined with the No. 2 cylinder centerline. This position is 180 degrees past the position (7) above. Adjust the tappet clearance of No. 2 cylinder.

(9) Install the gaskets and valve covers. Tighten the capscrew securely.

(10) Install the flywheel screen.

(11) Install the spark plug in No. 1 cylinder.

c. Removal.

(1) Remove the governor (par. 57c).

(2) Remove the cylinder heads (par. 101*a*).

(3) Remove the valve covers (par. 102*b*).

(4) Use a valve spring compressor and compress the valve spring. Remove the pair of valve spring seat locks, the valve stem roto cap, and valve spring seat. Remove the spring compressor, lift out the valve, and remove the valve spring.

Note. Tag or otherwise identify each valve and its parts so that they will be reinstalled in the same guide and valve chamber from which they were removed.

d. Cleaning and inspection.

(1) Clean the valves on a wire wheel brush to remove carbon from the valve face and gum deposits from the stems. Wash the springs with an approved cleaning solvent, and dry thoroughly.

(2) Use a rifle brush to clean out the valve guides in the cylinder block; blow out with compressed air.

(3) Clean the valve seat inserts and top of the cylinder block.

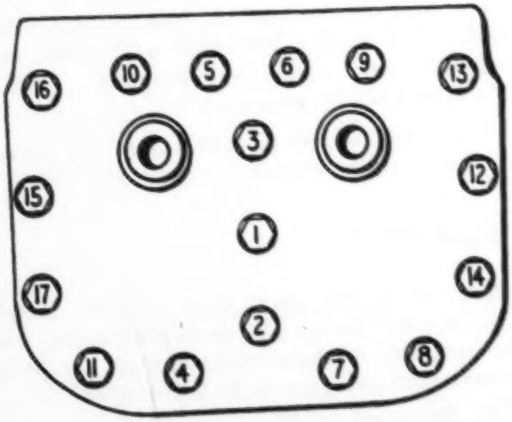


Figure 31. Cylinder head tightening sequence.

(4) Inspect the valves for burned, pitted, or cracked faces; replace a burned, cracked, or deeply pitted valve.

(5) Inspect the valve springs for brakes and wear. Compare with a new spring and replace if weak or damaged.

(6) Inspect the valve seat inserts for looseness and excessive wear.

(7) Inspect and replace all unserivceable parts.

e. Valve and valve seat refacing.

(1) Reface valves and valve seats only when there is evidence of warping or deep pits. A good method of detecting warping is to check each valve stem in a valve face grinder, and slowly rotate the valve while the grinding wheel is brought near the rotating valve face.

(2) Using a valve face grinder, reface the valves to an angle of 45 degrees. Replace any valve that measures less than 0.0625 inch from the top of head to the edge of the refaced outer circle.

(3) Install a pilot in the valve stem bore of the cylinder block. Set the stone on the valve reseating outfit to the angle of 45 degrees and dress the stone with the dresser. Place the grinder and stone assembly over the pilot in the valve stem bore, and grind just enough to make a smooth seat.

f. Valve grinding procedure.

(1) Remove all traces of cabon from the face of the cylinder block.

(2) Lightly coat the entire valve seat with a good quality water-soluble valve grinding compound. Slip a light lifting spring over the valve stem, and lubricate the stem. Drop the valve into its original place in the cylinder block. The lifting spring should barely hold the valve off its seat. Set the grinding tool on the valve head, and press down until the valve is seated. Turn the valve one-quarter turn, first in one direction, then in the other. Do this three or

four times. Release pressure on the valve so that the lifting spring will lift it from its seat, and turn the valve 10 degrees through 15 degrees to another position. Repeat the grinding. Do this until all of the compound is rubbed off the valve seat. Take out the valve, apply fresh compound, and repeat the grinding operation as necessary.

(3) Do not overgrind the valves. Occasionally clean the valve and its seat to see how the grinding is progressing. When all of the pits and grooves have disappeared, wipe the valve and its seat clean and place 3 to 10 soft pencil marks on the valve seat. Drop the valve in place. Turn it one-quarter turn, and remove. A perfect seat will be identified if every pencil mark shows where the valve has rubbed it. If any pencil marks remain untouched, continue the grinding.

(4) When the grinding is completed. clean off all traces of the cleaning compound. Check the valve seat for concentricity with a dial indicator.

g. Valve assembly installation.

(1) Place the valve springs (19, fig. 30) in their respective valve chambers.

(2) Insert the valves (9) into the same bores from which they were removed. Assemble the valve spring seats (20) on the valve stems. Compress the valve springs, and install the vlave spring seat locks (24).

(3) Install the valve covers.

(4) Install the cylinder heads.

(5) Install the governor.

Section IX. VALVE-SEAT INSERT

103. Description

The valve seats are replaceable, hardened inserts which are pressed into the cylinder blocks. The inserts should be replaced if they are pitted or burnt to the point where ordinary grinding procedures will not make them serviceable.

104. Valve-Seat Insert Replacement

a. Remove, clean, and examine the valves as instructed in paragraph 102.

b. Using a suitable puller, remove the exhaust valve-seat inserts. Take care not to damage the insert counterbore.

c. Clean all the carbon from the insert counterbore, and from the valve port.

Caution: Do not attempt to drive in an oversized insert before machining the counterbore.

d. Finish the counterbores in the cylinder blocks so that bore-to-insert interference is between 0.001 and 0.003 inch. Chill the inserts with dry ice; then, using a pilot driver, tap the insert in place with light blows. Peen the insert to anchor it in place.

e. Reface each insert if necessary to make their valve seats concentric with the valve-stem bore. Use a dial indicator and make sure that the valve seats are concentric. Regrind the valve seats if necessary.

f. Install the valves, and adjust the tappet-clearance as instructed in paragraph 102.

Section X. TIMING-GEAR TRAIN

105. Description

The timing-gear train is located at the same end of the engine as the flywheel, and is enclosed in a gear cover. It comprises the governor gear, camshaft gear, crankshaft gear, idler gear, oil-pump gear, and magneto gear. The magneto gear and the governor gear can be removed from the gear train without removing the gear cover. The reamining gears, with the execption of the crankshaft gear, can be removed after the gear cover is removed.

106. Removal of Timing-Gear Train

a. Remove the gear cover (17, fig. 28) and the spacer (14).

b. Remove the Allen-head setscrew from the left-hand side of the crankcase. Improvise a gear puller by using 3/8-inch flat washers, a 3/8-16NC x 4-inch bolt, and a socket of sufficient diameter to clear the shoulder of the idler gear shaft (29). Insert the bolt through the washers and socket; position the socket over the shoulder of the idler gear shaft so that the socket rests on the idler gear (29). Screw the bolt into the shaft and, using a wrench, take up on the bolt to remove the shaft; remove the shaft and idler gear.

c. Remove the three cap screws (7, fig. 32) and lockwashers (6) that secure the camshaft gear (5) to the camshaft. Pry the gear from the camshaft. Pull the camshaft thrust plunger (8) from the end of camshaft. Remove the plunger spring (9).

107. Cleaning and Inspection of Timing-Gear Train

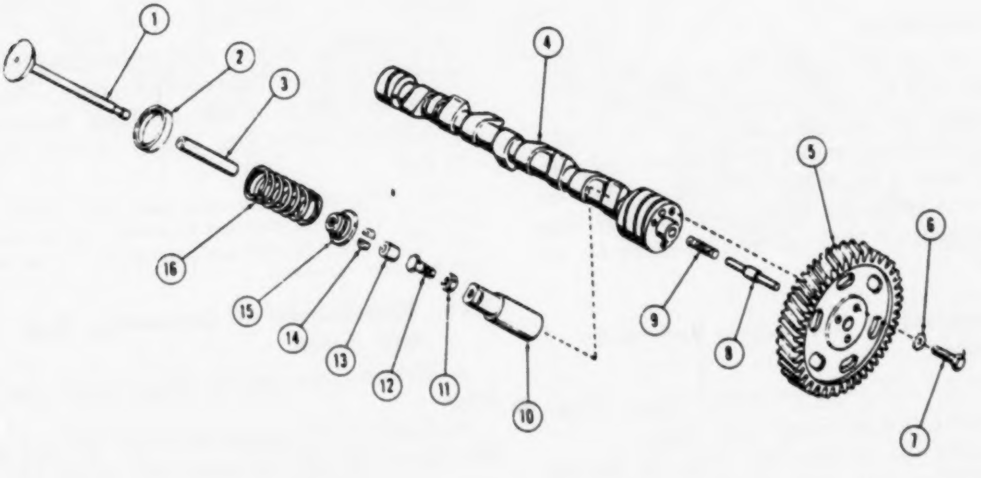
a. Wash the removed gears with an approved cleaning solvent; dry thoroughly. Discard the gear-cover gasket.

b. Clean the gear-cover spacer with a cloth dampened with an approved cleaning solvent; dry thoroughly.

c. Examine the gears for broken, cracked, or chipped teeth. Replace any damaged or excessively worn gears.

d. Inspect the idler gear shaft for scoring or pitting. Remove any roughness with a fine grade of emery cloth.

e. Examine the camshaft thrust-plunger spring for pits or breaks. Replace a defective spring.



1	Intake and exhaust valve
2	Valve seat insert
3	Valve stem guide
4	Camshaft
5	Camshaft gear
6	Everlock type lockwasher
7	Cap screw
8	Camshaft thrust plunger
9	Spring
10	Tappet
11	Locknut
12	Tappet screw
13	Rotator cap
14	Spring seat lock
15	Spring seat
16	Inlet and exhaust spring

Figure 32. Camshaft and valve, exploded view.

f. Examine the gear-cover spacer for breaks or cracks. Replace a defective gear-cover spacer and its gasket.

g. Check the hardware for rust and bad threads; replace any defective hardware.

108. Installation of Timing-Gear Train

a. Position the camshaft gear (5, fig. 32) on the end of the camshaft. The three holes in the camshaft and the gear are staggered in such a manner that they are lined up in only one position. At this position, the timing marks should aline with the mark on the crankshaft gear. Secure the camshaft gear in place with the three capscrews (7) and the three lockwashers (6). Tighten to 14–18 foot-pounds torque.

b. Install the thrust-plunger spring (9) and the thrust plunger (8) in the hollow end of the camshaft.

c. Install the woodruff key in the oil-pump shaft.

d. Slide the idler gear (29, fig. 28) over the idler gear stud (28) with the timing marks toward the shoulder of the idler gear shaft. Using a suitable fiber hammer, carefully drive the idler gear shaft into the case. Be sure that the oil groove is facing upward. The single mark on the idler gear should line up with the single mark on the crankshaft gear. Take care to allow an end clearance of approximately 0.005 inch. Install the setscrew in the crankcase, near the magneto, to secure the idler gear shaft.

e. Install the oil-pump drive gear as instructed in paragraph 99*f*.

f. Check the positions of all the gears and other components of the gear train, and install the gear cover in place.

g. Lubricate as instructed in the lubrication order.

Section XI. CONNECTING RODS AND PISTONS

109. Description

The pistons are made of heavy duty alloy castings, and are equipped with two compression rings, one scraper, and one oil-regulating ring. The upper end of the connecting rod is fitted with a hard bronze bushing. The end of the connecting-rod bearing is directly babbitted and fitted with laminated shims for adjusting.

110. Removal of Connecting Rod and Piston

a. Remove the cylinder heads (par. 101*a*).

b. Remove the oil pump (par. 99*b*)

c. Remove the carbon and ridge at the top of the cylinder bore with a ridge reamer.

d. Turn the crankshaft until the lower end of the desired connecting rod is accessible.

e. Remove the pairs of palnuts (23, fig. 33) from the connecting-rod bolts (31). Loosen the cap from the bolts by tapping it with a soft-faced hammer; remove the cap of the connecting rod (8).

Note. Some connecting rods are equipped with bearings.

f. Push the piston and connecting rod out through the top of the cylinder bore. Be careful not to scratch or mar the bore. Reassemble the connecting-rod cap loosely on the connecting rod.

Note. The connecting rods and caps are matched and must be paired together to insure correct installation. The caps and rods are marked with their respective cylinder numbers.

111. Disassembly of Connecting Rod and Piston

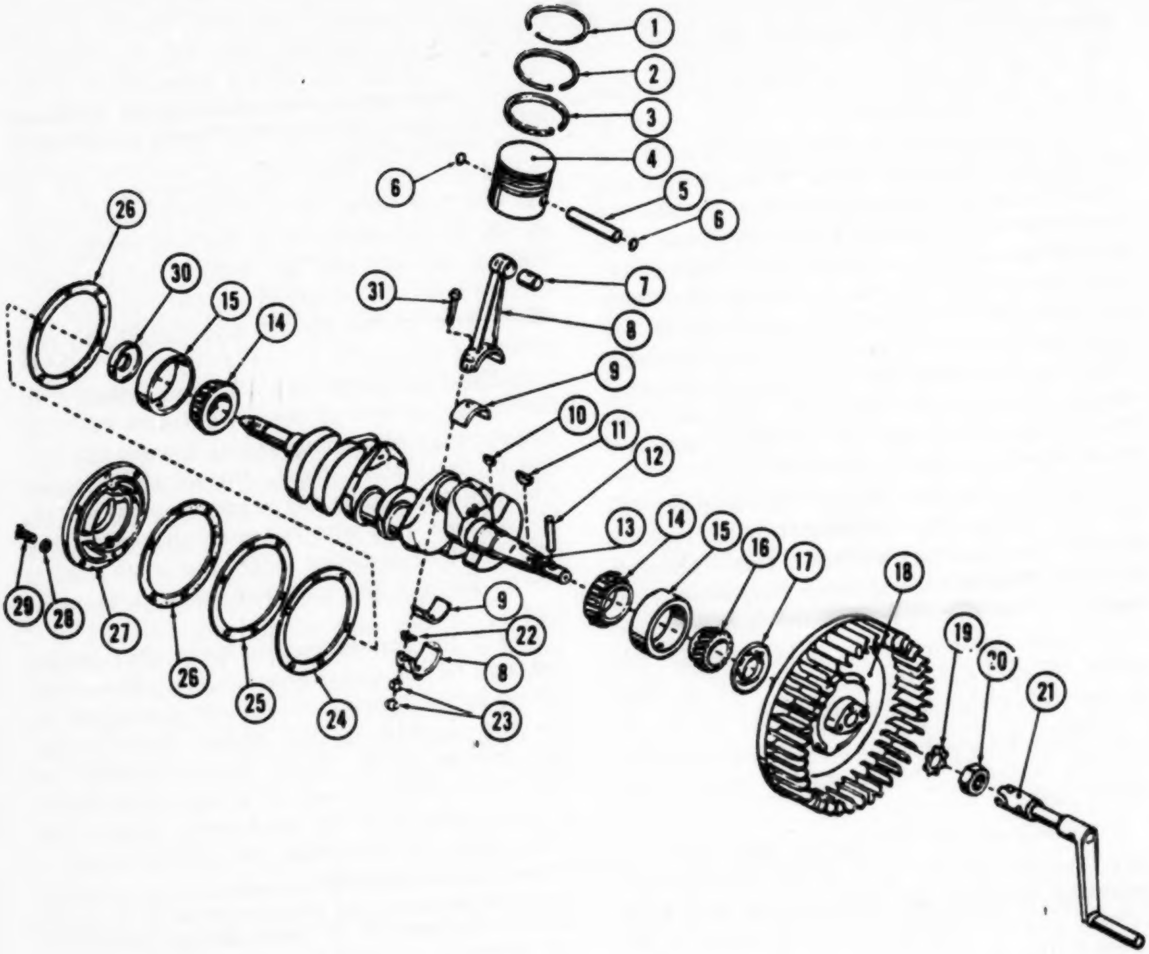
a. Remove the piston rings from the pistons.

b. Remove the retaining rings (6) and push the piston pin (5) out from the piston (4) and connecting rod (8).

c. Remove the piston-pin bushing (7). Place the connecting rod in a press, and press out the bushing.

112. Cleaning and Inspection of Connecting Rod and Piston

a. Using a wire brush, remove all carbon from the ring grooves in the pistons and from the top of the pistons, making sure that the oil holes in the lower ring grooves are open.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1 Compression ring
2 Scraper ring
3 Oil ring
4 Piston
5 Piston pin
6 Retaining ring
7 Piston pin bushing
8 Connecting rod
9 Shell bearing
10 Woodruff key
11 Woodruff key
12 Starting crank pin
13 Crankshaft
14 Bearing cone
15 Bearing cup
16 Crankshaft gear

Figure 33. Crankshaft, flywheel, connecting rod and piston, exploded view.

17 Oil slinger
18 Flywheel
19 Lockwasher
20 Nut
21 Starting crank
22 Shim
23 Palnut
24 Shim (0.006-in.)
25 Shim (0.014-in.)
26 Gasket (0.003-in.)
27 Bearing plate
28 Lockwasher
29 Cap screw
30 Oil seal
31 Connecting rod bolt

Figure 33—Continued

b. Wash all parts in an approved cleaning solvent; dry thoroughly.

c. Measure the cylinder bores with an inside micrometer. Measure the bore lengthwise and crosswise above the ring travels; repeat the measurement at the top of the ring travel. The difference in these measurements will determine the amount of wear in the cylinder bore, the taper, and out-of-round condition. If cylinder bores are worn more than 0.008 inch, rebore the cylinder with conventional reboring equipment and hone until the bores are not more than 0.001 inch out-of-round, and are not tapered more than 0.001 inch.

***Caution:* Before boring or honing the cylinder, wrap the crankshaft with rags to protect its bearing surfaces from abrasive particles. Measure the cylinder frequently while honing to keep from honing the bore oversize.**

d. Clean the carbon from the top of the piston. Clean the ring grooves with a ring-groove tool or a piece of an old ring.

e. Wash all of the parts with an approved cleaning solvent, and blow dry with compressed air.

f. To measure the piston-ring gap, place the ring into the cylinder bore in the approximate operating position, and measure the gap with a feeler gage. The gap clearance should be between 0.010 to 0.020 inch. If the ring is too small, use an oversize ring. If the gap is too small, clamp a file in a vise and position the ring on the file with the file in the ring gap. Lightly squeeze the ring together and move it back and forth to file both ends at one time. Measure the gap frequently to keep from filing off too much stock.

113. Reassembly of Connecting Rod and Piston (fig. 33)

a. Using a fiber hammer, tap the piston pin (5) into the piston (4) about 1 inch.

Note. Each pistion and connecting rod is marked for its cylinder; make sure that the parts are assembled in the proper position.

b. Place the proper connecting rod (8) in the matched piston so that the stamped arrow on top of the piston faces the side of the connecting rod opposite the oilhole in the connecting-rod cap. Tap the piston pin into the other bore of the piston, and install the two retaining rings (6).

c. Expand the oil ring (3), and install it in the bottom groove of the piston skirt with the scraper edge of the ring facing toward the bottom of the piston. Next, install the scraper ring (2), and finally the compression rings (1). The scraper ring also has a scraper edge; the ring must be installed with the edge facing down. Stagger the ring and gaps on the pistons.

d. Fit the connecting-rod bolts (31) in the rod, and fit the upper bearing half (9) so that oilhole in the bearing alines with the oilhole in the rod. Lightly oil the piston, piston rings, and cylinder walls. Turn the crankshaft so that the crankshaft journal to which the rod is to be attached is at top dead-center. Use a ring compressor to compress the piston rings.

Note. When installing the pistons in the cylinders, install the pistons so that the arrow on top of the piston points in the direction of crankshaft rotation. Piston and connecting rods must be reassembled into the same cylinder bore from which they were removed.

114. Installation of Connecting Rod and Piston

a. Lower the pistons into the cylinders as outlined in the above note. Using the butt end of a hammer handle, carefully push the piston and connecting rod into the cylinder until connecting rod rests on the crankshaft. This action will release the piston-ring compressor.

b. Assemble the lower bearing half (9) to the cap so that the oilholes aline. A number is stamped on each rod and cap to insure matching of the parts. Make sure the numbers agree for each rod and cap. Push the piston down while rotating the crankshaft to bottom dead-center. Position the cap on the rod so that its oilhole faces the oil-spray nozzle of the oil-header in the crankcase. Secure the assembly with the palnuts (23) and tighten each nut to 28–32 foot-pounds torque. Install the two palnuts (23) and tighten with a wrench one-fourth turn beyond finger tight position.

c. Using a suitable feeler gage, measure the side clearance between the bearing and crankshaft. The clearance should measure at least 0.008 inch and not more than 0.015 inch.

d. Install the oil pump as insructed in paragraph 99*f*.

e. Install the cylinder heads as instructed in paragraph 101*c*.

f. Invert the piston and slide it into the cylinder bore. Check the piston to cylinder clearance at the piston skirt thrust faces. The clearance should be 0.005 to 0.006 inch. If greater, replace the piston with an oversized one. Rebore and hone the cylinder as necessary.

g. Measure the piston ring side clearance. Replace the piston if the side clearance is not within the following tolerances:

Top ring	0.002 to 0.004 in.
2nd ring	0.0015 to 0.0035 in.
3d and 4th oil rings	0.001 to 0.003

h. Measure the fit of the piston pin in the piston. If the clearance exceeds 0.0005 inch, use an oversize piston pin and ram the piston and piston-pin bushing to fit. If new pistons are being used, ream the piston-pin bore in the piston not to exceed 0.0005–inch clearance.

i. Check the piston-pin bushing in the connecting rod for wear, scoring, or out-of-round condition. The clearance between the piston pin and bushing should not exceed 0.0011 inch. Ream and hone the bushing and piston to accommodate oversized piston pins (0.005-, 0.010-, 0.020-, and 0.030-inch oversized pins are available), or replace the bushings as necessary. When pressing in new bushings, be careful to aline the oilhole in the bushing with the oilhole in the connecting rod. Ream and hone new bushings to provide a clearance of 0.0001-0.0006 inch between the piston pin and bushing. The bushings are a press fit and in preparing the connecting rod for a new bushing ream the connecting rod 0.0025-0.0055 inch smaller than the outside diameter bushing.

j. Check the connecting rod for twist. Use bending bars to straighten twisted rods. Make sure that the oilholes in the connecting rods are open.

k. Inspect the connecting rod bearing halves for wear or scoring. Check the bearing to crank pin clearance; it should be between 0.0015 and 0.003 inches. Replace the bearing halves if worn beyond this limit.

Section XII. CRANKSHAFT AND CAMSHAFT

115. Description

The crankshaft is supported at both ends by roller bearings. The outer race or cup of the bearing at the power-takeoff and of the engine is carried in the main bearing plate, which is secured to the crankcase with cap screws and lockwashers. Shims are installed between the bearing plate and crankcase to provide the proper crankshaft end play. The camshaft is made of Gunite, and the cams and fuel pump eccentric integral with the shaft. It operates the valve tappets and fuel pump adapter. The two camshaft journals ride in honed bores in the crankshaft. The tappets are the mushroom type with self-locking adjusting screws, and ride in bores in the crankcase.

116. Crankshaft and Camshaft Removal and Disassembly

a. Crankshaft.

(1) Remove the cylinder heads and valves (par. 101*a*).

(2) Remove the fuel pump adapter (par 82*a*).

(3) Remove the gear cover (par. 106*a*).

(4) Remove the idler and camshaft gears (par. 106*b*).

Note. When removing camshaft and idler gear, tag each gear to facilitate installation.

(5) Remove the connecting rods and pistons (par. 110*f*).

(6) Remove the six capscrews and lockwashers that secure the main bearing plate to the crankcase; pry off the bearing plate, gaskets, and any installed shims.

Note. Keep the shims together so that the same shims will be reinstalled. If any are damaged, replace them with shims of the same thickness.

(7) Slide the oil slinger (17, fig. 33) from the flywheel end of the crankshaft (13), and carefully remove the assembled crankshaft through the rear opening of the crankcase.

(8) Remove the crankshaft gear (16) with a press plate by pressing the crankshaft through the gear with an arbor press; remove the woodruff key (10) from the crankshaft.

(9) Remove both bearing cones (14), and remove the cups (15) from the crankshaft.

b. Camshaft.

(1) Lift the valve tappets (10, fig. 32) up into the valve 3 chambers of the cylinder blocks, and secure them with wire to keep them free of camshaft.

(2) Screw a 5/16-18NC bolt into one of the camshaft-gear mounting holes in the front camshaft journal and, pulling on the bolt, carefully withdraw the camshaft.

(3) With a sharp chisel, punch a hole in the expansion plug (5, fig. 28) installed in the rear camshaft bore in the crankcase. Pry the expansion plug out with a screwdriver.

(4) Remove the three cap screws (41) and the lockwashers (42) that secure each splash plate (43) to the interior of the crankcase.

(5) Release the valve tappets, and remove them from the bottom of the crankcase. Identify each tappet to facilitate installation.

117. Crankshaft and Camshaft Cleaning, Inspection, and Repair

a. Crankshaft.

(1) Wash the removed crankshaft parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect the connecting-rod journals on the crankshaft for scoring. Hone the journals to remove any slight scoring, or replace a defective crankshaft.

(3) Measure the journals. Replace a crankshaft that is worn more than 0.002 inch. The diameter of the crankshaft journal should be between 2.123 and 2.125 inches.

(4) Check the main bearing plate and bearing retainer plate for cracks, breaks, or burs on the mating surfaces. File away any burs; replace a cracked or broken plate.

(5) Check the rear oil seal for damage or indication of wear. Replace a defective oil seal.

(6) Inspect the bearing cones and cups. Ordinarily they should be in good condition. Replace any defective bearing assembly.

(7) Inspect the hardware for bad threads, rust, or damage incurred during removal. If the screws have bad threads, replace the screws. Repair the mounting holes by running a tap into them. Replace any other defective hardware.

(8) Replace the main bearing-plate gaskets.

b. Camshaft.

(1) Wash the camshaft and tappets with an approved cleaning solvent; dry thoroughly.

(2) Inspect the camshaft for alinement, scoring, and roughness on the cams and journals. Repair any slight roughness, or replace a badly scored camshaft.

(3) Measure the camshaft journals and cams; replace the camshaft if either the journals or cams are worn beyond the limits of allowable wear. The No.

1 camshaft journal should be between 1.8723 and 1.8732 inches. The smaller No. 2 journal should be between 1.2473 and 1.2482 inches.

(4) Measure the camshaft journals and the camshaft bores in the crankcase. If the difference in diameters exceeds 0.0035 inch, try measuring a new camshaft and again note the difference in dimensions. If the difference in diameters still exceeds 0.0035 inch, replace the crankcase. If the difference in diameter is less than 0.002 inch, ream and hone the crankshaft bores.

(5) Inspect the tappets. If they show signs of wear, replace them. Replace a defective or worn adjusting screw.

(6) Inspect the splash plates for bends or dents. Ordinarily they should be in good condition. Repair a bent or dented splash plate.

118. Crankshaft and Camshaft Reassembly and Installation

a. Camshaft.

(1) Position the two splash plates (43, fig. 28) in the crankcase, and secure them with the cap screws (41) and lockwashers (42).

(2) Apply a thin coat of oil to the tappets (10, fig. 32) and install them in the proper bores in the crankcase. Place a prop under the tappets so as to clear the camshaft when it is installed.

(3) Apply a thin coat of oil to the camshaft (4), and install it in the crankcase. Install a new expansion plug. Remove the props from under the tappets.

b. Crankshaft.

(1) Press the bearing cones (14, fig. 33) on the crankshaft.

(2) Install the key (10) in the crankshaft keyway. Aline the keyway in the crankshaft gear (16) with the installed key, and press the gear in the shaft.

(3) Assemble the oil seal in its retainer and press the assembly into the main bearing plate with the retainer facing toward the exterior face of the plate.

(4) Press the bearing cup into the main bearing plate.

(5) Apply a coat of bearing grease to the roller bearings on the bearing cones. Coat the cups with grease.

(6) Carefully lead the crankshaft into the crankcase through the rear opening of the crankcase. Engage the crankshaft gear in the gear train so that the punched timing mark on the camshaft gear alines with the timing mark of the crankshaft gear.

(7) Apply a thin coat of grease to the two gaskets (26). Position the thicker gaskets (24) around the rear opening of the crankcase and the gasket on the main bearing plate.

(8) Install the bearing plate and shims on the crankcase; secure them with the six cap screws and lockwashers. Tighten the cap screws to 25-30 foot-pounds torque.

(9) Use a dial indicator, and set its contact point against the end of the crankshaft. With a screwdriver, pry the crankshaft back and forth, being careful not to damage the connecting-rod journals. If the end play of the crankshaft exceeds 0.004 inch, remove shims to adjust. Add shims if there is not at least 0.002 inch end play.

(10) Install the connecting rods and pistons (par. 114).

(11) Install the idler and camshaft gears (par. 108*d*).

(12) Install the gear cover (par. 108*f*).

(13) Install the fuel pump (par. 54*d*).

(14) Install the cylinder heads and valves (pars. 101*c* and 102*g*).

Section XIII. CYLINDER BLOCKS AND CRANKCASE

119. Description

a. Crankcase. The crankcase is a one-piece casting machined at the top and fitted with studs to mount the two cylinder blocks. The camshaft bores are honed, and serve as bearing surfaces for the camshaft.

b. Cylinder blocks. The cylinder blocks are cast in pairs and are provided with cooling fins. The valve-stem guide bores are machined in each of the blocks.

120. Cylinder Block Removal

a. Remove the valves (par. 102*c*).

b. Remove the connecting rods and pistons (par. 110).

c. Remove the six nuts (17, fig. 30) and lockwashers (18) that secure each cylinder block (7) to the crankcase; remove the cylinder blocks and gaskets (23). Tag them so that they will be reinstalled on the same side of the crankcase from which they were removed.

121. Cylinder Block Cleaning and Inspection

a. Clean, inspect, and repair the cylinder bores as necessary.

b. Clean, inspect, and repair the valve seats and bores as necessary.

c. Use a wire brush, compressed air, and an approved cleaning solvent to clean the cooling fins of the blocks. Inspect the cylinder blocks for cracks, breaks, or damaged cooling fins. Replace a defective cylinder block.

d. Inspect the manifold mounting studs, cylinderblock mounting studs, and mounting hardware. Tighten any loose mounting studs; replace any defective hardware.

e. Examine the threaded cylinder-head mounting holes. Repair any holes that have bad threads.

f. Replace the cylinder-block gaskets.

122. Cylinder Block Installation

a. Position a new gasket (23, fig. 30) over the studs of the crankcase. Install the appropriate cylinder block (7) and secure it with the six lockwashers (18) and nuts (17). Tighten the nuts to 62–78 foot-pounds torque.

b. Install the pistons and connecting rods (par. 114).

c. Install the valves (par. 102*g*).

123. Crankcase Disassembly

a. Remove the timing gears (par. 106*b*).

b. Remove the crankshaft (par. 116*a*).

c. Remove the camshaft (par. 116*b*).

d. Remove the cylinder blocks (par. 120).

e. To remove a defective oil filler tube (2, fig. 28), crush the tube and withdraw it from the crankcase.

124. Crankcase Cleaning and Inspection

a. Steam the crankcase, or wash it with a wire brush and an approved cleaning solvent to remove all rust and scale; dry thoroughly.

b. Examine the oil filler tube for corrosion, bends, or dents. Repair or replace the oil filler tube as necessary.

c. Examine the camshaft bores. Replace a defective crankcase.

d. Examine the entire crankcase for cracks or breaks. Replace a defective crankcase.

125. Crankcase Reassembly

a. If the oil filler tube was removed, chill a new one with dry ice, and install it in the crankcase.

b. Install the camshaft (par. 118).

c. Install the crankshaft (par. 118).

d. Install the timing gears (par. 108).

e. Install the cylinder blocks (par. 122).

f. Lubricate the entire pump unit according to the lubrication guide (fig. 8).

g. Start the unit and check for signs of unusual operation.

Section XIV. CHECK VALVE

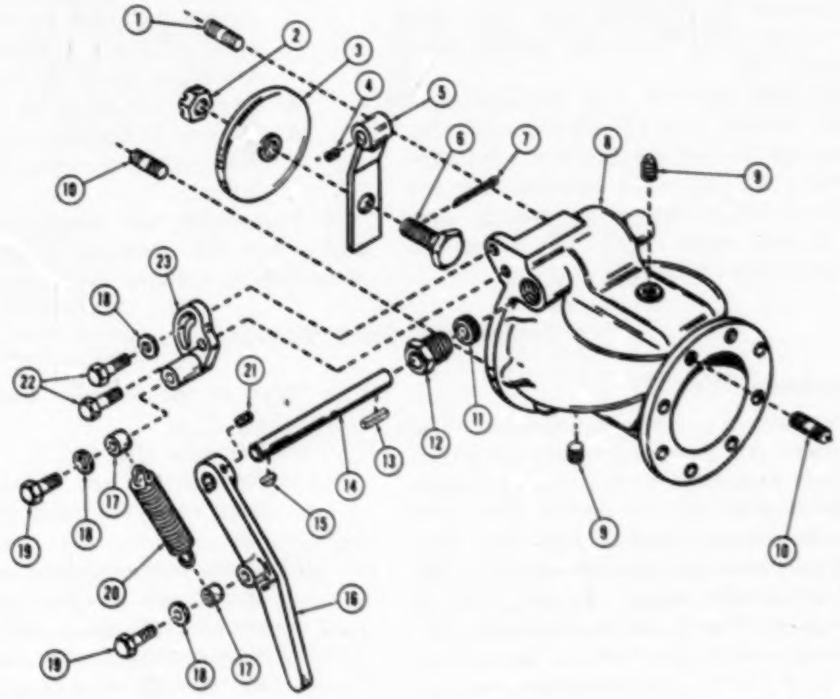
126. Description

The check valve (fig. 34) is a lever-operated discharge valve. This valve is adjusted at the factory to close automatically when the pump is shut down or can be adjusted to remain open. The adjustment of the valve is made by the positioning bracket (23), so that the spring (20) will either hold the valve open or pull the valve to the closed position. Under most conditions, the valve should be positioned to close automatically when the pumping operation ceases to retain liquid in the pump and suction hose. This will save time in subsequent operation by eliminating or reducing the time required for priming the pump. When it is desirable to drain the discharge hose, and providing the discharge hose is higher than the pump, manually open the automatic discharge valve by means of the lever (16). The contents in the discharge hose can then drain back through the pump and the suction hose to the fuel supply source.

127. Check Valve Replacement

a. Removal.

(1) Remove the nuts, bolts, and lockwashers at the discharge elbow flange.



1	Stud	7	Cotter pin	13	Key	19	Capscrew
2	Hex nut	8	Body	14	Shaft	20	Spring
3	Valve weight	9	Pipe plug	15	Woodruff key	21	Setscrew
4	Setscrew	10	Stud	16	Lever	22	Cap screw
5	Weight arm	11	Packing	17	Spacer sleeve	23	Spring bracket
6	Shoulder screw	12	Nut	18	Washer		

Figure 34. Check valve, exploded view.

(2) Remove the nuts and lockwashers securing the check valve to the discharge elbow on the pump.

(3) Remove the check valve and gaskets.

b. Disassembly (fig. 34).

(1) Remove the capscrew (19), washer (18), and sleeve (17) and disconnect the spring (20) from the lever (16).

(2) Remove the capscrews (19 and 22), washers (18), and sleeve (17) and remove the bracket (23) and the spring (20).

(3) Unscrew the setscrew (21) and slide off the lever (16) from the shaft (14). Remove the key (15).

(4) Remove the packing nut (12) and packing (11) from the check valve body (8).

(5) Unscrew the setscrew (4) and slide the weight arm (5) on the shaft far enough to remove the key (13). Remove the key (13) and pull out the shaft (14); remove the weight arm (5) and valve weight (3) from the check valve body (8).

(6) Remove the cotter pin (7), nut (2), and shoulder screw (6). Remove the weight (3) from the weight arm (5).

(7) Remove the plugs (9) from the check valve body (8).

c. Cleaning and inspection.

(1) Wash all parts with an approved cleaning solvent and dry thoroughly with compressed air or a clean cloth.

(2) Inspect the shaft for wear and damage. Replace a defective shaft.

(3) Inspect the check valve body for cracks and breaks; replace if necessary.

(4) Inspect all mounting and assembly screws and studs for stripped or damaged threads. Replace damaged screws or studs as necessary.

(5) Replace a broken or cracked spring.

(6) Discard the gaskets; remove and use new gaskets for reassembly and installation.

d. Reassembly and installation. Reassemble and install the check valve following the instructions in *b* above in the reverse order.

Section XV. GATE VALVES

128. Description (fig. 35)

The gate valve is a valve in which the line-closing element is a gate in the form of a disk (10) which is raised out of the way by means of a threaded stem (8) to permit flow, and lowered by the same means to halt flow. The line-closing element is composed of two disks separated by a split wedge. As the stem is turned to close the valve, the disks descend until they are directly opposite the port. Then the action of the beveled surfaces between the two disks forces the disks apart squarely against their seats, thus eliminating sliding action on the valve seats. Gate valves are operated at fully open or fully closed positions. If the gate fails to close, it may be abraded by dirt and scale in the fuel to point where it will no longer serve as a tight valve.

129. Gate Valve Maintenance and Repair

a. Removal. To remove a gate valve, remove the nuts, bolts, and lockwashers securing the gate valve at the flanges. Remove the valve and gasket.

b. Disassembly (fig. 35).

(1) Remove the nut (2) and lift off the handwheel (3) from the bonnet stem (8).

(2) Remove the packing nut (4), gland spring (5), packing gland (6), and packing (7) from bonnet (1).

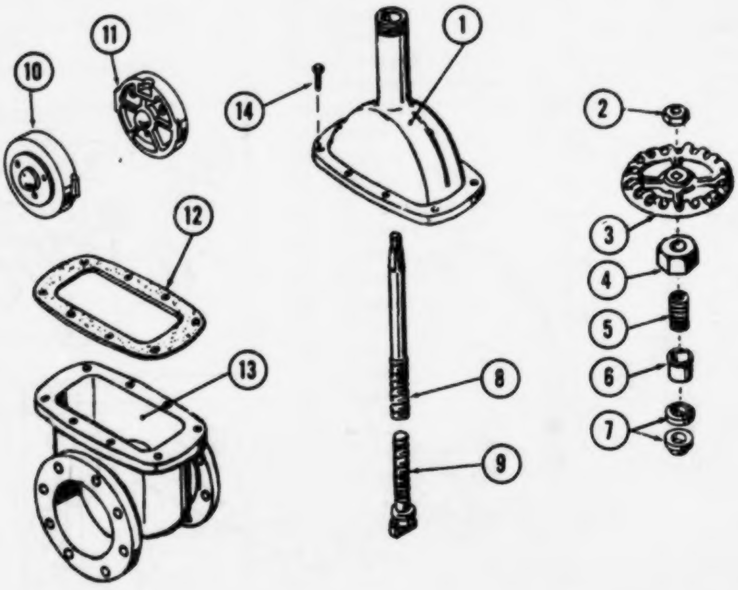
(3) Remove the bonnet screws (14) and lift off the bonnet (1) and gasket (12) from the valve body (13).

(4) Lift out the bonnet stem (8), disk stem (9), and the two disks (10 and 11) as a unit from the body (13).

(5) Unscrew the disk stem (9) from the bonnet stem (8), and remove the disks (10 and 11) from the disk stem.

c. Cleaning, inspection, and repair.

(1) Wash all parts with an approved cleaning solvent and dry thoroughly with compressed air.



1	Bonnet	8	Bonnet stem
2	Wheel nut	9	Disk stem
3	Handwheel	10	Male disk
4	Packing nut	11	Female disk
5	Gland spring	12	Gasket
6	Packing gland	13	Body
7	Packing	14	Bonnet screw

Figure 35. Gate valves, 4-inch, exploded view.

(2) Inspect the body for cracks and breaks. Inspect the valve seats for pitting, grooves, cracks, and excessive wear. Replace a defective valve body. If the valve seats are slightly pitted, pits can be removed with emery cloth. Be sure to clean the surfaces evenly to assure a proper seating of the disk.

(3) Inspect the disks for wear and damage. Replace a worn or damaged disk.

(4) Inspect the valve stem to see if it is bent or the threads are damaged.

(5) Discard used gaskets and packing. Use new gaskets and packing when reassembling.

(6) Replace all worn or damaged assembly screws and nuts.

d. Reassembly and installation. Reverse the procedures outlined in a and b above.

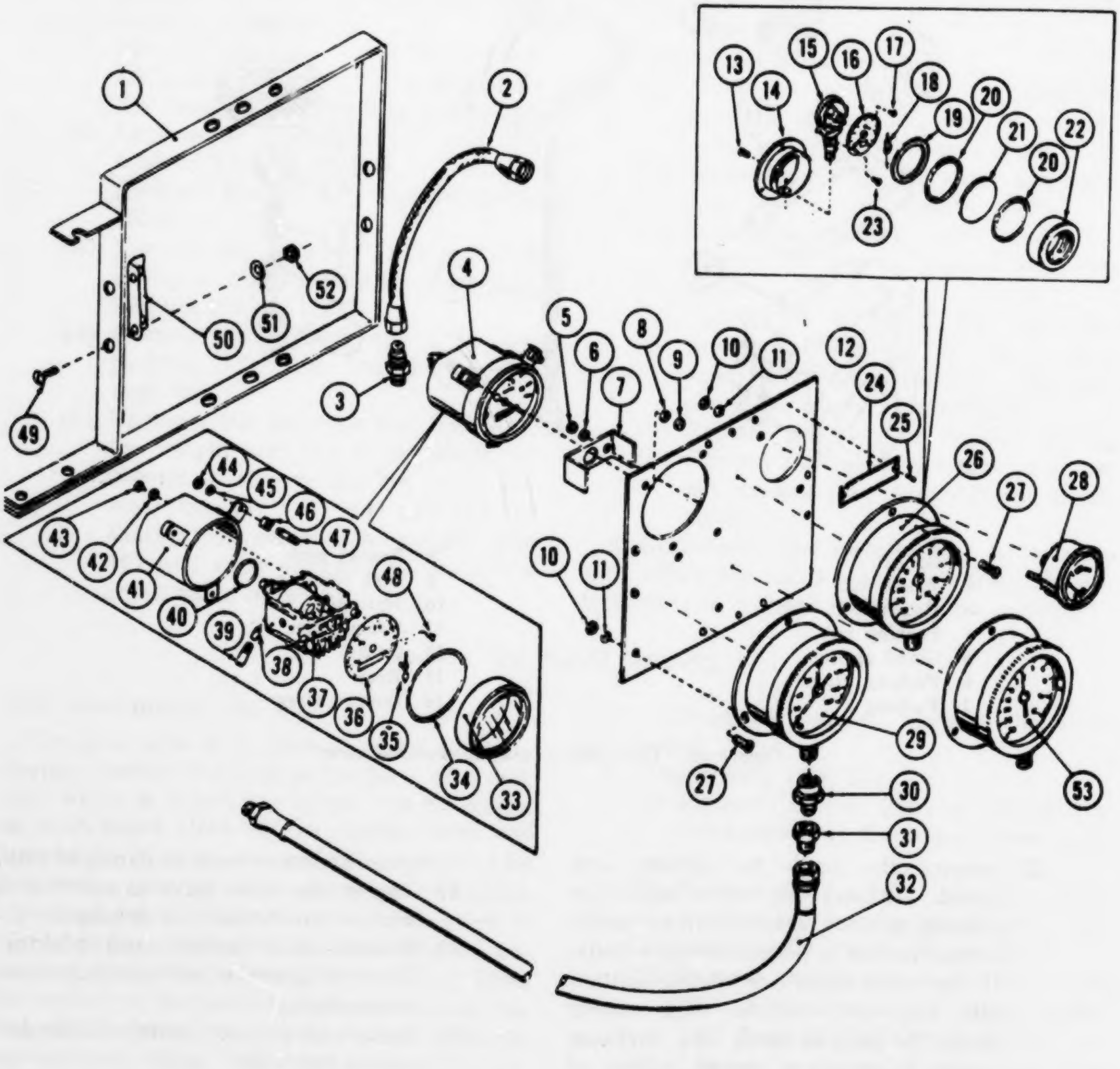

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Figure 36. Instrument panel, exploded view.

1	Support bracket	19	Retaining ring	37	Movement
2	Pressure gage oil line	20	Gasket	38	Packing
3	Bushing	21	Glass	39	Oiler
4	Hourmeter-tachometer	22	Threaded ring	40	Gasket
5	Hex nut	23	Dial lower screw	41	Case
6	Lockwasher	24	Manufacturer's name plate	42	Washer
7	Clamp plate	25	Screw	43	Screw
8	Lockwasher	26	Gage	44	Hex nut
9	Hex nut	27	Screw	45	Lockwasher
10	Hex nut	28	Oil pressure gage	46	Spacer
11	Lockwasher	29	Pressure gage	47	Stud
12	Instrument panel	30	Snubber	48	Dial screw
13	Screw	31	Connector	49	Machine screw
14	Case	32	Assembly hose	50	Rubber support
15	System assembly	33	Bevel	51	Flat washer
16	Dial	34	Gasket	52	Hex nut
17	Dial upper screw	35	Pointer	53	Gage
18	Flourescent pointer	36	Dial		

Figure 36—Continued

Section XVI. INSTRUMENT PANEL

130. General

a. Mounted on the instrument panel (12, fig. 36) are the following instruments. Hourmeter-tachometer (4), pressure gage (29), oil pressure gage (28), vacuum gage (26) and pump suction gage (53).

b. The instrument panel and its cluster of gages is mounted on the left side of the pump and so located that all gages are clearly visible to the operator at all times. The above gages provide the operator with a constant check on the operation of the engine and pump. Any malfunction of the pump or engine will be detected on the reading on the gages. Refer to paragraphs 30 through 44 for probable causes and possible remedies when unit fails to operate properly. Shut down unit and correct malfunctioning before resuming operation.

131. Replacement of Instrument Panel Components

a. General. The instruments mounted on the panel are precision instruments and with proper care, seldom will it be necessary to replace them. However, when it is definitely found that the gage is defective, the pump unit should not be operated until the defective gage is replaced.

b. Removal and installation. The instrument panel and gages illustrated in the exploded view of figure 36 shows the instruments in their relative positions and clearly illustrates how the components can be removed and installed. Detailed instructions have been omitted herein to eliminate all repetitious and unnecessary text. Refer to TM 5-4320-218-35P for nomenclature and part numbers for requisition purposes.

Section XVII. PUMP AIR ELIMINATOR AND SUCTION MANIFOLD

132. Pump Air Eliminator

a. Removal and disassembly (fig. 37).

(1) Loosen the screw on the clamp (20) and disconnect the hose (21).

(2) Remove the screws (8) and lift out the air eliminator (6) and gasket (5).

(3) Remove the pivot pin (30) and remove the float (24) and valve lever clip (26).

(4) Remove the valve collar clip (25), valve (27), valve seat (28), and valve lever (29).

(5) Remove the draincock (19) and pipe connector (33). Remove the ball (32) from the cover (31).

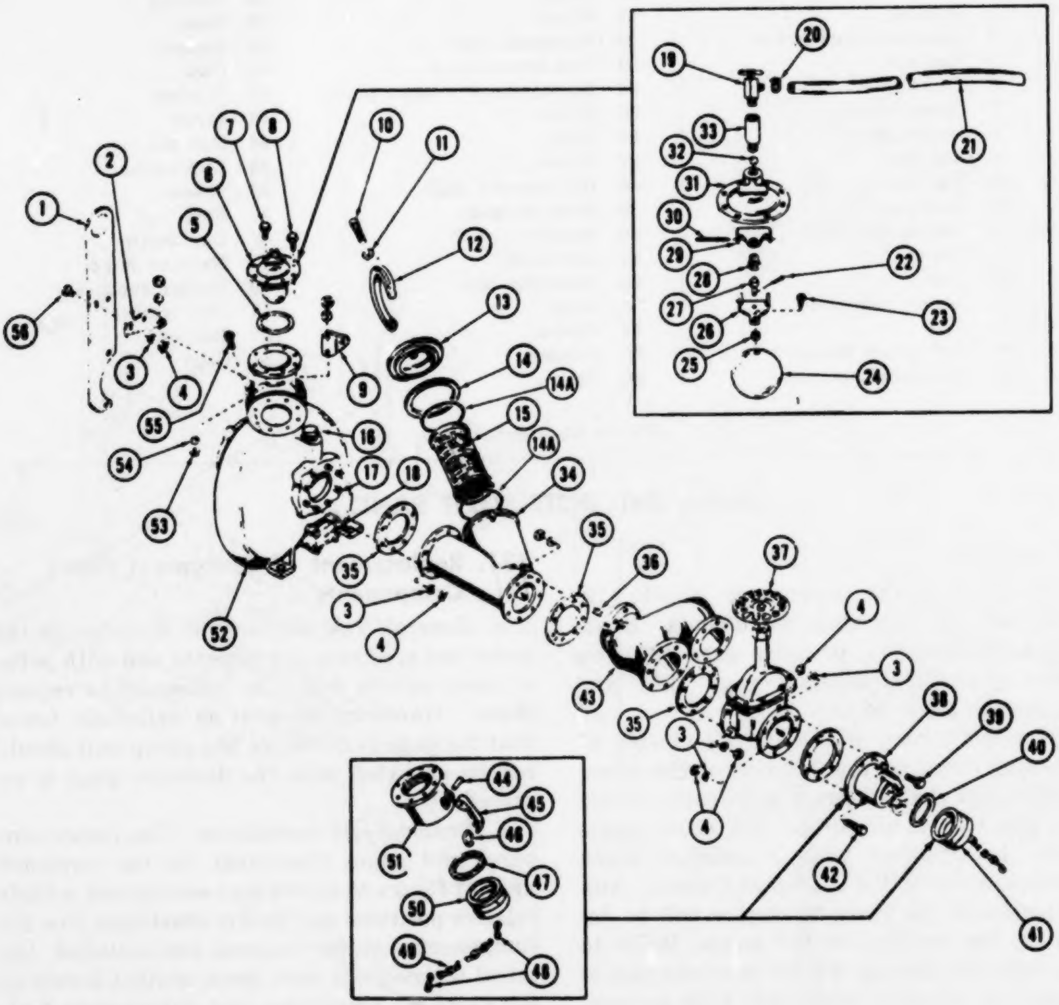
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Figure 37. Pump air eliminator and suction manifold, exploded view.

1	Lifting bail	15	Screen	29	Valve lever	43	Suction manifold
2	Support	16	Adapter (male)	30	Pivot pin	44	Cam arm pin
3	Lockwasher	17	Stud	31	Cover	45	Cam arm
4	Hex nut	18	Cover plate	32	Ball	46	Cam arm ring
5	Gasket	19	Drain cock	33	Pipe connector	47	Dust plug gasket
6	Eliminator assembly	20	Hose clamp	34	Strainer body	48	"S" hook
7	Cap screw	21	Thin wall hose	35	Gasket	49	Chain
8	Cap screw	22	Cotter pin	36	Stud	50	Dust plug body
9	Throttle bracket	23	Screw	37	Gate valve	51	Coupler body
10	Setscrew	24	Float	38	Flange coupler	52	Pump
11	Jam nut	25	Valve collar	39	Cap screw	53	Hex nut
12	Yoke	26	Valve lever clip	40	Gasket	54	Lockwasher
13	Cover	27	Valve	41	Dust plug	55	Cap screw
14 & 14A.	Gaskets	28	Valve seat	42	Cap screw		

Figure 37—Continued

b. Cleaning and inspection.

(1) Clean all parts with an approved cleaning solvent and wipe dry with a clean lintless cloth.

(2) Inspect the cover for cracks and breaks. Replace a defective cover if necessary.

(3) Inspect the float for holes and cracks. Replace a defective float.

(4) Inspect all fittings and screws for damage. Replace any defective part as necessary.

(5) Inspect all fittings and screws for damage. Replace any defective part as necessary.

(6) Discard the gasket and use a new gakset for reassembly.

(7) Inspect the valve and seat for wear, grooves, or ridges. Replace the valve and seat as an assembly if worn or damaged.

c. Reassembly and installation. Reverse the procecures outlined in a above.

133. Suction Manifold (fig. 37)

a. Removal and disassembly.

(1) Remove the screws (42), nuts (4), and lockwashers (3) securing the flange coupler (38) to the flange of each gate valve (37).

(2) Remove the nuts (4) and lockwashers (3) securing the gate valves (37) to the suction manifold (43).

(3) Remove the nuts (4) and lockwashers (3) securing the suction manifold (43) to the strainer body (34). Remove the suction manifold.

(4) Unscrew jam nut (11) and setscrew (10), and remove the yoke (12).

(5) Remove the cover (13) and gasket (14), and lift out the screen (15).

(6) Remove the nuts (4) and lockwashers (3) securing the strainer body (34) to pump (52).

(7) Discard all gaskets removed.

b. Cleaning and inspection.

(1) Clean all parts with an approved cleaning solvent and dry thoroughly with compressed air or a clean lintless cloth.

(2) Inspect the suction manifold, flange couplers, and strainer body for cracks, breaks, and damage. Replace any part if necessary.

(3) Inspect all studs, nuts, and bolts for stripped, worn, or damaged threads. Replace any part if necessary.

(4) Inspect the screen for holes and damage. Replace a damaged screen.

(5) Inspect the dust plugs and couplers for damage and stripped threads. Replace a damaged coupler if necessary.

c. Reassembly and installation. Reassemble and install each part removed by reversing the procedures given in a above.

Section XVIII. PUMP DISCHARGE MANIFOLD

134. General (fig. 38)

The purpose of the pump discharge manifold (8) is to provide a multiple connection for discharge hoses. Two 4-inch gate valves (12) are mounted on the manifold. Each gate valve is equipped with a flange adapter (11) and dust cap (13).

135. Pump Discharge Manifold Maintenance and Repair

a. Removal and disassembly.

(1) Remove the dust caps (13).

(2) Remove the nuts (5) and lockwashers (4) and cap screws (7) securing the adapters to the gate valves (12). Remove the adapters and gaskets (3 and 11).

(3) Remove the nuts (5) and lockwashers (4) securing the gate valves (12) to the discharge manifold (8). Remove the gate valves and gaskets.

(4) Remove the nuts (5) and lockwashers (4) and remove the discharge manifold (8) from discharge elbow (6).

b. Cleaning, inspection, and repair.

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Discard all gaskets removed and use new gaskets for reassembly.

(3) Inspect all hardware for stripped threads and wear. Replace any part necessary.

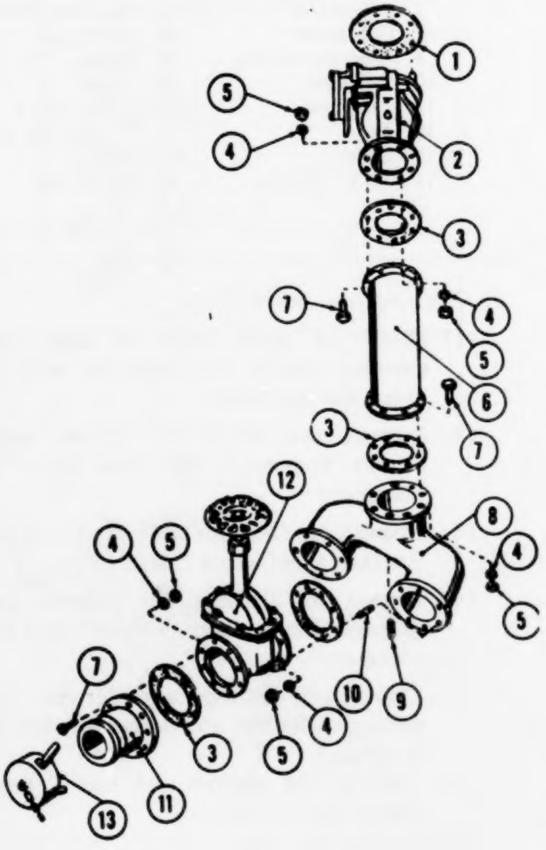
(4) Inspect the manifold for cracks and holes. Inspect the manifold flanges for warpage and cracks. Replace a defective manifold.

(5) Refer to paragraph 129 for maintenance and repair of the gate valves.

(6) Inspect the dust caps for broken chains, worn cam arms, and cam arm pins. Replace worn arms and pins.

(7) Inspect the extension pipes for cracks and damaged threads. Replace a damaged pipe.

c. Reassembly and installation. Reverse the procedure outlined in *a* above.



1	Gasket and valve seat
2	Valve assembly check
3	Gasket
4	Lockwasher
5	Hex nut
6	Discharge elbow
7	Cap screw
8	Discharge manifold
9	Pipe plug
10	Stud
11	Flange adapter
12	Gate valve assembly
13	Dust cap

Figure 38. Pump discharge manifold, exploded view.

Section XIX. PUMP ASSEMBLY

136. Pump Disassembly (fig. 39)

a. Remove the pump discharge manifold (par. 135).

b. Remove the check valve (par. 127).

c. Remove the instrument panel (par. 131).

d. Remove the pump air eliminator and suction manifold (pars. 132*a* and 133*a*).

e. Remove the nuts (10) and lockwashers (11) and remove the discharge elbow (9) and gasket (12).

f. Remove the adapter (18).

g. Insert a piece of soft metal (heavy gage sheet aluminum) through the top of the volute (15) and between the sides of the impeller and between any two ribs. The piece of soft metal must be long enough to rest against the volute opening. Turn the crankshaft sharply counterclockwise to break the contact between the thread in the impeller and the thread on the crankshaft. If the edges of the impeller ribs are chipped or damaged the impeller will be thrown out of balance. To correct this condition it will be necessary to file the edges of the impeller ribs so all are alike.

h. Remove the nuts (22), lockwashers (23) and cap screws (24) securing the base of the pump volute (15) to the trailer.

i. Remove the nuts (27) and lockwashers (26) securing the intermediate (3) and the pump volute (15).

j. Slide the pump volute (15) away from the engine and remove from the trailer.

k. Unscrew the impeller (7) from the end of the shaft. Remove the impeller ring (8).

l. Remove the spacer sleeve (6) and seal assembly (5).

m. Remove the cap screws (2) and lockwashers (1) and remove the intermediate (3).

137. Maintenance and Repair of Pump

The construction of the pump is such that little maintenance is required. The two main points requiring service are the shaft seal assembly (5, fig. 39) and the wear ring (8).

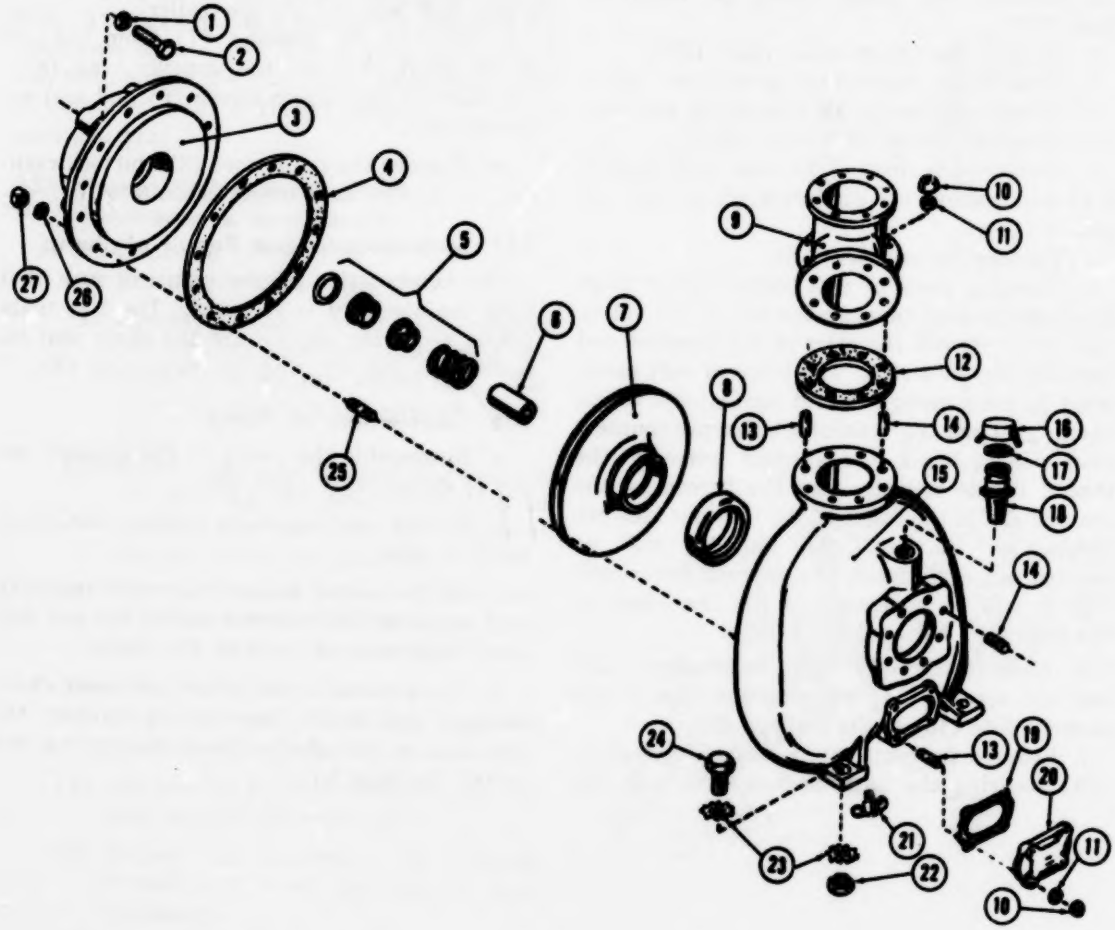
138. Reassembly of Pump

a. Reassemble the pump in the opposite order of disassembly (par. 136).

b. Firmly and squarely install stationary parts in bore.

c. Oil the sleeve spacer (6); place rotating seal assembly (5) with the end of the seal surface flush with the end of the sleeve.

d. Place sleeve on the shaft and push sleeve through seal until sleeve butts against the shoulder on the shaft. Insert the spring and install the impeller.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1	Lockwasher
2	Cap screw
3	Intermediate
4	Intermediate gasket
5	Seal assembly
6	Sleeve spacer
7	Impeller
8	Impeller ring
9	Discharge elbow
10	Hex nut
11	Lockwasher
12	Gasket
13	Stud
14	Stud
15	Volute
16	Dust cap
17	Gasket
18	Adapter
19	Gasket
20	Cover plate'
21	Drain cock
22	Hex nut
23	Lockwasher
24	Capscrew
25	Stud
26	Lockwasher
27	Hex nut

Figure 39. Pump and intermediate parts, exploded view.

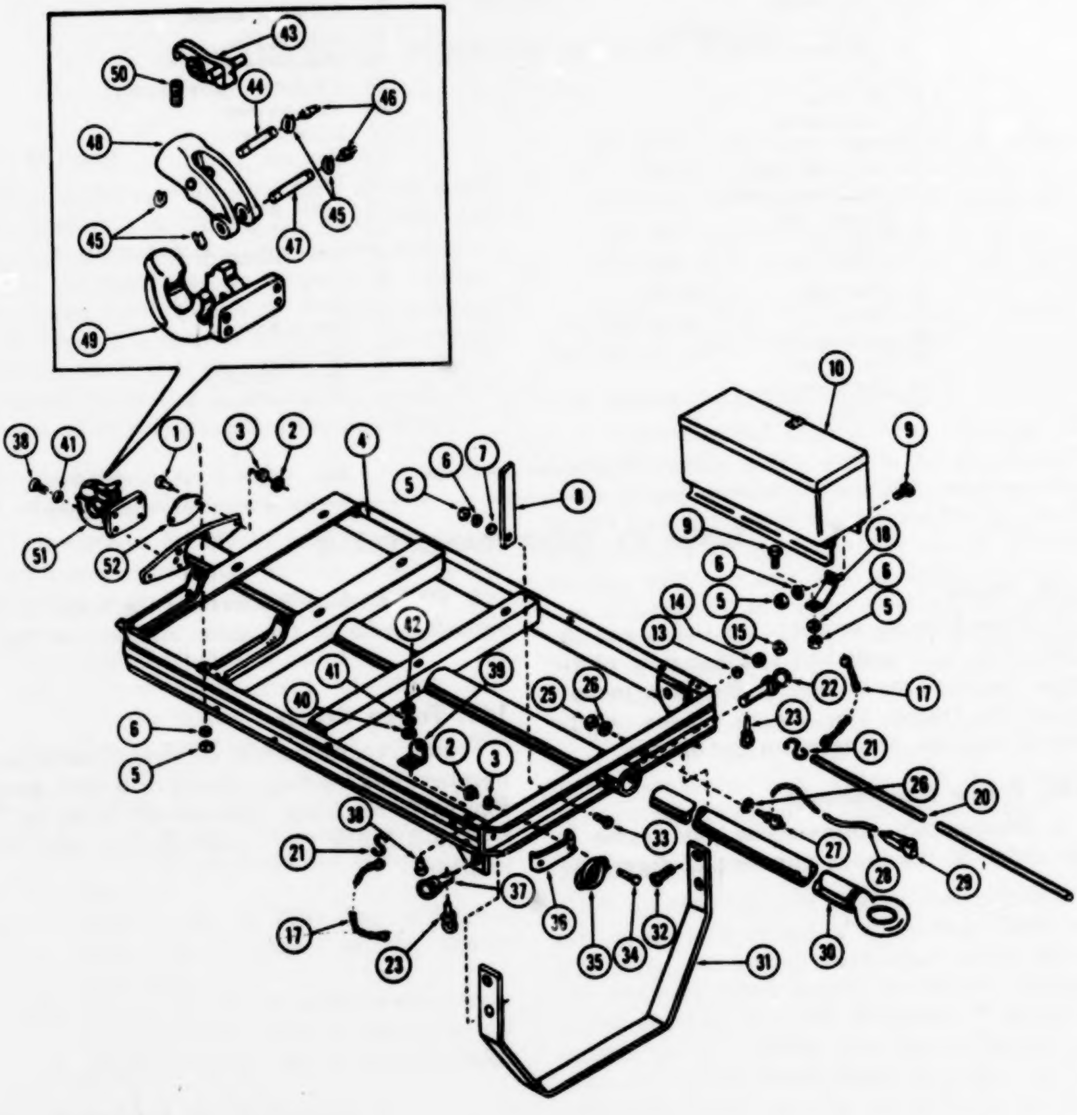
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Figure 40. Pump, trailer, toolbox, towing eye and pintle hook, exploded view.

1	Machine screw
2	Hex nut
3	Lockwasher
4	Frame
5	Hex nut
6	Lockwasher
7	Flat washer
8	Suction valves support
9	Cap screw
10	Tool box
13	Bushing
14	Lockwasher
15	Nut
17	Weldless chain
18	Tool box bracket
20	Ground rod
21	S-hook
22	Anchor pin
23	Snap pin
25	Nut
26	Lockwasher
27	Cap screw
28	Wire braid
29	50-amp clip
30	Tongue
31	Front stand
32	Bolt
33	Cap screw
34	Screw
35	Amber reflector
36	Reflector spacer
37	Anchor pin
38	Cap screw
39	Discharge valve support
40	Flat washer
41	Lockwasher
42	Hex nut
43	Latch
44	Short pin
45	Snap ring
46	Lube fitting
47	Long pin
48	Lock
49	Pintle hook
50	Spring
51	Hook assembly
52	Ruby reflector

Figure 40—Continued

Section XX. PUMP TRAILER FRAME

139. Frame

A welded frame supports the pump and engine. The fuel tank, bail and hangers, pintle hook, towing tongue, and toolbox are mounted on the frame. The towing tongue can be moved into the frame when not in use.

140. Frame Maintenance

a. Disassembly. Disassemble the frame in the order of the index numbers of figure 40.

b. Reassembly. Reassemble the frame in the opposite order of the index numbers of figure 40.

141. Frame Repair

Frame repairs consist of straightening bent members and welding cracked or broken pieces. For parts requiring replacement, refer to TM 5-4320-218-35P for nomenclature and part numbers.

CHAPTER 5

DEMOLITION OF PUMP TO PREVENT ENEMY USE

142. General

When capture or abandonment of the pump to an enemy is imminent, the responsible unit commander must make the decision either to destroy the equipment or to render it inoperative. Based on this decision, orders are issued which cover the desired extent of destruction. Whatever method of demolition is employed, it is essential to destroy the same vital parts of all pumps and all corresponding repair parts.

143. Demolition to Render the Equipment Inoperative

a. Demolition by Mechanical Means. Use a sledge hammer, pickaxe, or any other heavy tool which may be available to destroy the following:

(1) Engine block and manifold.
(2) Carburetor, magneto, governor, and cylinder heads.
(3) The pump volute, check valve, and manifolds.

b. Demolition by misuse. Perform the following steps to render the pump inoperative.

(1) Drain the oil from the engine crankcase.
(2) Remove the oil filler cap and place sand, dirt, or rocks in the engine crankcase.
(3) Disconnect the governor control lever and allow the engine to operate at ungoverned speed until equipment falls.

144. Demolition by Explosives or Weapons Fire

a. Explosives. Place as many of the following charges (fig. 41) as the situation permits and detonate them simultaneously with detonating cord and a suitable detonator.

(1) One 1/2 pound charge under manifold.
(2) One 1/2 pound charge on magneto.
(3) One 1/2 pound charge on pump
(4) One 1/2 pound charge on right side of axle.

b. Weapons Fire. Fire on the pump with the heaviest practical weapons available.

145. Other Demolition Methods

a. Scattering and Concealment. Remove all easily accessible parts, such as the air cleaner, spark plugs, carburetor, magneto, and governor and scatter them through dense foilage, bury them in dirt or sand, throw them in a lake, stream, well, or other body of water.

b. Burning. Pack rags, clothing, or canvas under and around the unit. Saturate this packing with gasoline, oil, or diesel fuel and ignite.

c. Submersion. Remove the spark plugs from the engine and totally submerge the unit in a body of water to provide water damage and concealment. Salt water will do greater damage to metal parts than fresh water.

146. Training

All operators should receive thorough training in the destruction of the pump. Refer to FM 5-25. Simulated destruction, using all of the methods listed above, should be included in the operator training program. It must be emphasized in training that demolition operations are usually necessitated by critical situations when time available for carrying out destruction is limited. For this reason, it is necessary that operators be thoroughly familiar with all methods of destruction of equipment, and be able to carry out demolition instructions without reference to this or any other manual.

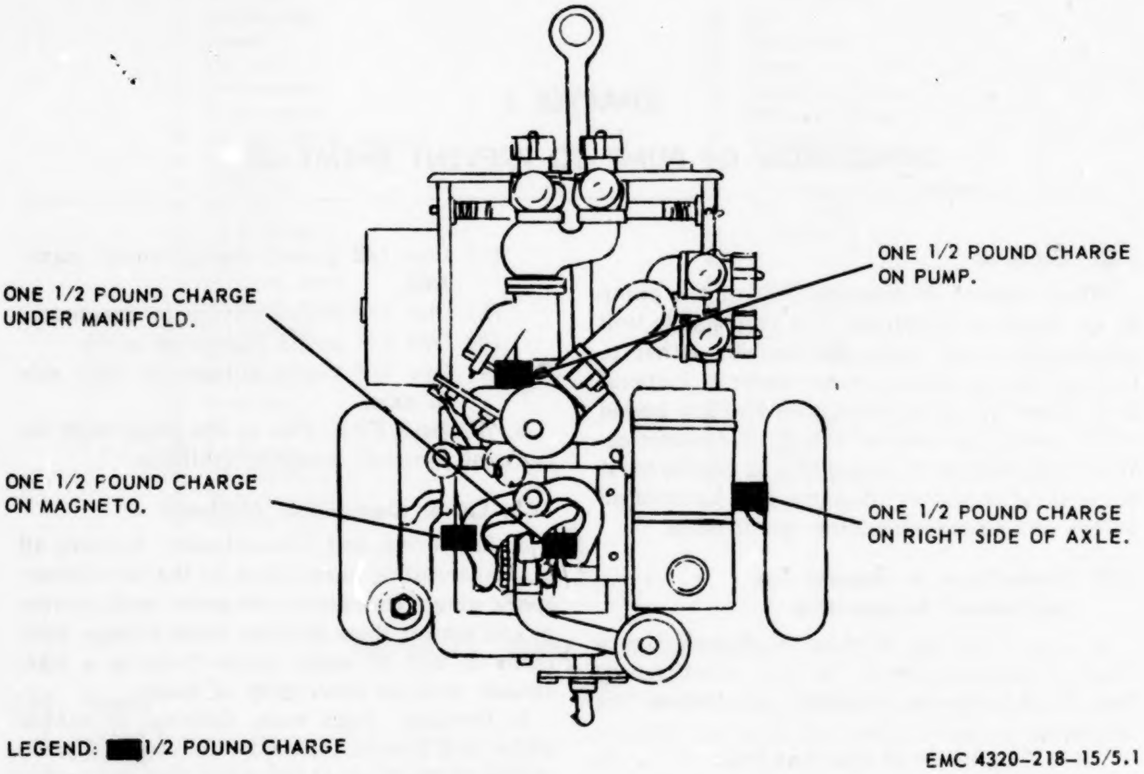
ONE 1/2 POUND CHARGE ON PUMP.
ONE 1/2 POUND CHARGE UNDER MANIFOLD.
ONE 1/2 POUND CHARGE ON MAGNETO.
ONE 1/2 POUND CHARGE ON RIGHT SIDE OF AXLE.
LEGEND: ■ 1/2 POUND CHARGE
EMC 4320-218-15/5.1

Figure 41. Placement of charges.

APPENDIX I

REFERENCES

1. Dictionaries of Terms and Abbreviations

AR 320-5	Dictionary of United States Army Terms.
AR 320-50	Authorized Abbreviations and Brevity Codes.

2. Fire Protection

TM 5-687	Repairs and Utilities: Fire Protection Equipment and Appliances; Inspections, Operations, and Preventive Maintenance.
TM 9-1799	Ordnance Maintenance: Fire Extinguishers.

3. Lubrication

LO 5-4320-218-15	Pump, Centrifugal: Petroleum; Gasoline Driven; Trailer Mounted; 4 in; 350 gpm, 275 ft head (Gorman-Rupp Model 04A12-MVG4D) With Wisconsin Engine Model MVG4D.

4. Painting

TM 9-2851	Painting Instructions for Field Use.

5. Preventive Maintenance

AR 700-38	Unsatisfactory Equipment Report.
AR 750-5	Maintenance Responsibilities and Shop Operation.
TM 5-505	Maintenance of Engineer Equipment
TM 9-1870-1	Care and Maintenance of Pneumatic Tires.

6. Publication Indexes

DA Pam 108-1	Index of Army Motion Pictures, Film Strips, Slides, and Phono-Recordings.
DA Pam 310-1	Index of Administrative Publications.
DA Pam 310-2	Index of Blank Forms.
DA Pam 310-3	Index of Training Publications
DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Lubrication Orders, and Modification Work Orders.
DA Pam 310-5	Index of Graphic Training Aids and Devices.
DA Pam 310-25	Index of Supply Manuals—Corps of Engineers.

7. Radio Interference Suppression

TM 11–483	Radio Interference Suppression.

8. Shipment and Limited Storage

AR 743–505	Limited Storage of Engineer Mechanical Equipment.
TM 9–200	General Packaging Instructions for Ordnance General Supplies.

9. Supply Publications

SM 10–1–C4–1	Petroleum, Petroleum-Base Products and Related Materiel.
TM 5–4320–218–20P	Organizational Maintenance Repair Parts and Special Tool Lists. Pump, Centrifugal: Petroleum; Gasoline Driven; Trailer Mounted; 4 in; 350 gpm, 275 ft head (Gorman-Rupp Model 04A12–MVG4D) FSN 4320–691–1071.
TM 5–4320–218–35P	Field and Depot Maintenance Repair Parts and Special Tool Lists Pump, Centrifugal: Petroleum; Gasoline Driven; Trailer Mounted; 4 in, 350 gpm, 275 ft head (Gorman-Rupp Model 04A12–MVG4D) FSN 4320–691–1071.

10. Training Publications

FM 5–25	Explosives and Demolition.
FM 21–5	Military Training.
FM 21–6	Techniques of Military Instruction.
FM 21–30	Military Symbols.

APPENDIX II

MAINTENANCE ALLOCATION CHART

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1. General

The Maintenance Allocation Chart lists all maintenance and repair operations authorized for the various echelons.

2. Maintenance

Maintenance is any action taken to keep materiel in a serviceable condition or to restore it to serviceability when it is unserviceable. Maintenance of materiel includes the following:

a. Service. To clean, to preserve, and to replenish fuel and lubricants.

b. Adjust. To regulate periodically to prevent malfunction.

c. Inspect. To verify serviceability and to detect incipient mechanical failure by scrutiny.

d. Test. To verify serviceability and to detect incipient mechanical failure by use of special equipment such as gages, meters, and so on.

e. Replace. To substitute serviceable assemblies, subassemblies, and parts for unserviceable components.

f. Repair. To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This function includes but is not limited to, inspecting, cleaning, preserving, adjusting, replacing, welding, riveting, and straightening.

g. Overhaul. To restore an item to *completely serviceable* condition as prescribed by serviceability standards developed and published by heads of technical services. This is accomplished through employment or the technique of "Inspect and Repair only as Necessary" (IROAN). Maximum utilization of diagnostic and test equipment is combined with minimum disassembly of the item during the overhaul process.

3. Explanation of Columns

a. Functional Group. The functional group is a numerical group set up on a functional basis. The applicable functional grouping indexes are taken from the Corps of Engineers Functional Grouping Indexes, and appear on the Maintenance Allocation Chart in their correct numerical sequence. These indexes are normally set up according to their proximity to each other and their function.

b. Components and Related Operation. This column contains the functional description of the part starting with the noun name. It also designates the operation to be performed such as service, adjust, inspect, test, replace, repair, and overhaul.

c. Echelon Maintenance.

Column 1. First Echelon: First echelon maintenance is that maintenance performed by the user or operator of the equipment, such as servicing, cleaning, lubricating, and limited adjustments. It also includes removal and replacement of items to accomplish servicing and lubrication.

Column 2. Second Echelon: Second Echelon maintenance is that maintenance performed by trained personnel provided for that purpose in the using organization, such as replacement of all items in column 2, limited parts fabrication from bulk material, adjustments, and repair of assemblies, components, and end items that can be accomplished without extensive disassembly.

Column 3. Third Echelon: Third echelon maintenance is that maintenance performed by specially trained units in direct support of the using organization, such as replacement of all items in columns 2 and 3, repair assemblies, components, and end items, and fabricate parts from bulk material.

Column 4. Fourth Echelon: Fourth Echelon maintenance is that maintenance performed by units organized as semifixed or permanent shops to serve lower echelon maintenance within a geographical area, such as replacement of items in columns 2, 3, and 4, repair end items, overhaul assemblies, components, and fabricate general use common hardware and parts.

Column 5. Fifth Echelon: Fifth echelon maintenance is that maintenance authorized to overhaul assemblies, components, end items, and replacement of all parts in columns 2, 3, 4, and 5.

d. Symbol "X". The symbol X in the appropriate column indicates the lowest echelon responsible for performing that particular maintenance operation, but does not necessarily indicate repair parts will be stocked at that level.

e. Remarks. The remarks column is used to explain why maintenance that would normally be done at a lower echelon is moved to a higher echelon because of some peculiarity in the construction of the end item.

MAINTENANCE ALLOCATION CHART

Functional group	Components and related operation	Echelons of maintenance					Remarks
		1	2	3	4	5	
01	ENGINE						
0100	ENGINE ASSEMBLY						
	Engine Assembly						
	Service	X					
	Inspect	X					
	Test		X				Compression
	Replace			X			
	Repair			X			
	Overhaul				X		
0101	CRANKCASE, BLOCK, CYLINDER HEAD						
	Cylinder Head						
	Replace		X				
0102	CRANKSHAFT						
	Crankshaft						
	Replace						
	Repair					X	Metalize, Resize, Aline
	Bearings and Seals						
	Replace				X		
0103	FLYWHEEL ASSEMBLY						
	Flywheel				X		
	Replace		X				
0104	PISTONS, CONNECTING RODS						
	Piston Assembly						
	Replace				X		
	Repair				X		
	Rod Assembly						
	Replace				X		
	Repair				X		
0105.1	VALVES						
	Valves and Seats						
	Replace			X			
	Repair			X			Reface
	Guides and Springs						
	Replace			X			
0105.2	ROCKER ARMS, TAPPETS						
	Tappets						
	Adjust		X				
	Replace				X		
0105.3	CAMSHAFTS						
	Camshaft						
	Replace				X		
	Thrust Plunger and Spring						
	Replace			X			
0105.5	TIMING GEARS						
	Gears						
	Replace				X		
0106.1	OIL PUMP						
	Pump Assembly						
	Replace			X			
	Repair			X			

Functional group	Components and related operation	Echelons of maintenance					Remarks
		1	2	3	4	5	
0106.2	OIL FILTERS						
	Filter Assembly						
	Service	X					
0106.5	CRANKCASE VENTILATION						
	Breather Assembly						
	Service	X					
	Replace		X				
0106.6	OIL PAN, LINES, LEVER GAGE						
	Lines						
	Replace		X				Fabricate
0108	MANIFOLDS						
	Manifolds						
	Replace		X				
0111.1	HAND CRANKING DEVICES						
	Crank, Hand Starting						
	Replace	X					
03	FUEL SYSTEM						
0301	CARBURETOR						
	Carburetor						
	Adjust	X					External
	Replace		X				
0302.4	FUEL PUMP, GASOLINE						
	Fuel Pump						
	Replace		X				
0304	AIR CLEANER						
	Air Cleaner						
	Service	X					
0306	TANKS, LINES, FITTINGS						
	Fuel Tank						
	Service	X					
	Repair			X			
	Lines						
	Replace		X				Fabricate
	Cap, Fuel Tank						
	Replace		X				Chained
0308	ENGINE SPEED GOVERNOR						
	Governor						
	Replace		X				
	Repair				X		
0309	FUEL FILTERS						
	Filter, Fuel						
	Service	X					
0312	ACCELERATOR, THROTTLE OR CHOKE CONTROL						
	Throttle Control						
	Replace		X				
	Choke Control						
	Replace		X				

Functional group	Components and related operation	Echelons of maintenance					Remarks
		1	2	3	4	5	
04	EXHAUST SYSTEM						
0401	MUFFLER AND PIPES						
	Muffler						
	Replace		X				
05	COOLING SYSTEM						
0502	COWLING, DEFLECTORS, AIR DUCT, SHROUD						
	Shrouds						
	Replace		X				
06	ELECTRICAL SYSTEM (ENGINE AND VEHICULAR)						
0604.2	MAGNETO						
	Magneto Assembly						
	Service		X				
	Adjust		X				
	Replace		X				
	Repair			X			Install Kit
0604.6	IGNITION COIL, WIRING, SPARK PLUGS						
	Spark Plugs						
	Service		X				
	Adjust		X				
	Replace		X				
0607	INSTRUMENT OR ENGINE CONTROL PANEL						
	Switch, Ignition						
	Replace		X				
0615	RADIO SUPPRESSION						
	Capacitor						
	Replace		X				
	Strap						
	Replace		X				
11	REAR AXLE						
1100	REAR AXLE ASSEMBLY						
	Axle Assembly						
	Replace		X				
1101	HOUSING BEAM, HOUSING COVERS PLUGS						
	Axle						
	Replace		X				
13	WHEELS AND TRACKS						
1311	WHEEL ASSEMBLY						
	Bearings						
	Service	X					
	Replace		X				
1313	TIRES, TUBES						
	Tires, Tubes						
	Service	X					
	Replace		X				
	Repair		X				

Functional group	Components and related operation	Echelons of maintenance					Remarks
		1	2	3	4	5	
15	FRAME						
1501	FRAME ASSEMBLY						
	Frame						
	Replace			X			
1503	PINTLES AND TOWING ATTACHMENTS						
	Tongue, Towing						
	Replace		X				
	Pintle Hook Assembly						
	Replace		X				
1507	LANDING GEAR; LEVELING JACKS						
	Stand Front						
	Replace		X				
17	BODY; CAB; HOOD; HULL						
1708	STOWAGE RACKS, BOXES, STRAPS						
	Tool Box						
	Replace		X				
22	MISCELLANEOUS BODY, CHASSIS OR HULL AND ACCESSORY ITEMS						
2201	CANVAS ITEMS						
	Cover						
	Replace	X					
2202.1	REFLECTORS						
	Reflectors						
	Replace		X				
2210	DATA PLATES AND INSTRUCTION HOLDERS						
	Plate, Instruction						
	Replace		X				
	Plate, Identification (C.O.E.)						
	Replace			X			
47	GAGES (NON-ELECTRICAL); WEIGHING AND MEASURING DEVICES						
4701.2	TACHOMETER						
	Tachometer-Hourmeter						
	Replace		X				
4703.1	OIL PRESSURE GAGES						
	Gage, Oil Pressure						
	Replace		X				
	Hose Assembly						
	Replace		X				Fabricate
4709	PRESSURE GAGES						
	Gage, Pressure						
	Replace		X				
	Hose Assembly						
	Replace		X				Fabricate

Functional group	Components and related operation	Echelons of maintenance					Remarks
		1	2	3	4	5	
4709.1	VACUUM GAGES						
	Gage, Vacuum						
	Replace		X				
	Hose Assembly						
	Replace		X				Fabricate
4712	GAGE MOUNTINGS						
	Panel, Gage Mounting						
	Replace		X				
55	PUMPS (EXCLUDE ENGINE PUMPS)						
5500	PUMP ASSEMBLY						
	Pump Assembly						
	Service	X					
	Replace			X			
	Repair			X			
	Overhaul				X		
5501	VOLUTE, HOUSING						
	Volute						
	Replace			X			
5502	IMPELLER, ROTOR, DIAPHRAGM						
	Impeller						
	Replace			X			
	Seals, Sleeve						
	Replace			X			
5504	DISCHARGE ASSEMBLY						
	Intermediate						
	Replace			X			
5504.1	DISCHARGE VALVE						
	Valve, Discharge						
	Replace		X				
	Repair		X				Packing
5504.2	SUCTION VALVE, SUCTION HEADS						
	Valve, Suction						
	Replace		X				
	Repair		X				Packing
	Strainer Sediment						
	Service	X					
	Replace		X				
5504.3	PRIMING DEVICES						
	Eliminator Assembly						
	Replace		X				
	Repair		X				
	Hose						
	Replace		X				
76	FIRE FIGHTING EQUIPMENT						
7603	FIRE EXTINGUISHER						
	Extinguisher, Fire						
	Replace	X					

APPENDIX III

BASIC ISSUE ITEMS LIST

Section I. INTRODUCTION

1. General

Section II lists the accessories, tools, and publications required in 1st echelon maintenance and operation, initially issued with, or authorized for the Pump, Centrifugal.

2. Explanation of Columns

a. Source Codes. The information provided in each column is as follows:

(1) *Technical services.* The basic number of the Technical Service assigned supply responsibility for the item is shown. Those spaces with no number shown are Corps of Engineers supply responsibility. Other Technical Service basic numbers are:

10—Quartermaster Corps
12—Adjutant General's Corps

(2) *Source.* The selection status and method of supply are indicated by the following code symbols:

(*a*) P—applied to repair parts which are high mortality parts, procured by technical services, stocked in and supplied from the technical service depot system, and authorized for use at indicated maintenance echelons.

(*b*) P1—applied to repair parts which are low mortality parts, procured by technical services, stocked only in and supplied from technical service key depots, and authorized for installation at indicated maintenance echelons.

(3) *Maintenance.* The lowest maintenance echelon authorized to use, stock, install, or manufacture the part is indicated by the following code symbol:

O—Organizational Maintenance
(1st and 2d Echelons)

b. Federal Stock Numbers. When a Federal stock number is available for a part, it will be shown in this column, and used for requisitioning purposes.

c. Description.

(1) The item name and a brief description of the part are shown.

(2) A five-digit Federal supply code for manufacturers and/or other technical services is shown in parentheses followed by the manufacturer's part number. This number will be used for requisitioning purposes when no Federal stock number is indicated in the Federal stock number column. *Example:* (08645) 86453.

(3) The letters GE, shown in parentheses immediately following the description, indicate General Engineer supply responsibility for the part.

d. Unit of Issue. Where no abbreviation is shown in this column, the unit of issue is "each."

e. Expendability. Those items classified as nonexpendable are indicated by letters "NX." Items not indicated by "NX" are expendable.

f. Quantity Authorized. This column lists the quantities of repair parts, accessories, tools, or publications authorized for issue to the equipment operator or crew as required.

g. Quantity Issued with Equipment. This column lists the quantities of repair parts, accessories, tools, or publications that are initially issued with each item of equipment. Those indicated by an asterisk are to be requisitioned through normal supply channels as required.

h. Illustrations. This column is subdivided into two columns which provide the following information:

(1) *Figure number*. The identifying number of the illustration.

(2) *Item number*. The referred number for the part shown in the illustration.

3. Index to Federal Supply Code for Manufacturers

66289	Wisconsin Motor Corp.
25567	Gorman Rupp Co.

4. Comments and Suggestions

Suggestions and recommendations for changes to the Basic Issue Items List will be submitted on DA Form 2028 to the Commanding General, U. S. Army Engineer Maintenance Center, EMCDM, Corps of Engineers, P. O. Box 119, Columbus 16, Ohio. ATTN: EMCDM, Direct communication is authorized.

Section II. BASIC ISSUE ITEMS LIST

Source codes				Federal stock no.	Description	Unit of issue	Expendability	Qty authorized	Qty issued with equipment	Illustration	
Technical service	Source	Maintenance	Recoverability							Fig.	Item
					GROUP 01 ENGINE 0111.1 HAND OR CRANKING DEVICES						
	P	O			CRANK: Starting (66289) UA30A			1	1		
					GROUP 22 MISCELLANEOUS BODY, CHASSIS OR HULL AND ACCESSORY ITEMS 2201 CANVAS ITEMS						
	P	O			PAULIN, W/ROPE			1	1		
					GROUP 26 ACCESSORIES, PUBLICATIONS AND TOOLS 2602.1 ACCESSORIES						
10	P	O		7520-559-9618	CASE, MAINTENANCE AND OPERATIONAL MANUALS: Cotton-duck, water repellent and mildrew resistant.			1	1		
	P	O			ROD: Grounding (25567) 6919			1	1		
					2602.4 PUBLICATIONS						
12	P	O			DEPARTMENT OF THE ARMY OPERATOR, ORGANIZATIONAL, FIELD AND DEPOT MAINTENANCE MANUAL, TM 5-4320-218-15			2	2		
12	P	O			DEPARTMENT OF THE ARMY LUBRICATION ORDER, LO 5-4320-218-15			1	1		
					GROUP 76 FIRE FIGHTING EQUIPMENT 7603 FIRE EXTINGUISHER						
	P1	O	S	5120-288-8269	EXTINGUISHER, FIRE, VAPORIZING, LIQUID: Carbon tetrachloride (GE)			1	1		
	P1	O		4210-555-8837	EXTINGUISHER, FIRE MONOBROMOTRIFLUOROMETHANE: Charged hand shatterable cylinder, penetrating seal valve, stored pressure w/bracket 2.75 lbs (Halon-1301) Mil Spec E-52031 (GE) *Note.* Requisition CTC/CO_2 Extinguishers until Depot Stocks are exhausted.			1	(*)		
	P1	O		4210-708-0030	CYLINDER, CHARGE			1	(*)		

APPENDIX IV

MAINTENANCE AND OPERATING SUPPLIES

A listing of all oils, grease, and fuel required for the initial operation of the Centrifugal Pump is shown below. Numbers appearing in the source of supply column indicate the supplying technical service basic number. The number 10 in this column indicates Quartermaster Corps.

MAINTENANCE AND OPERATING SUPPLIES

Item	Component application	Source of supply	Federal stock No.	Description	Quantity required for initial operation	Quantity required for 8 hours operation	Notes
1.	0101 CRANKCASE (1)			Oil, Lubricating: 3 gal drum as follows.			(1) Includes quantity of oil to fill engine oil system (2) See SM 10-1 C4-1 for additional data and requisitioning procedure. (3) See LO 5-4320-218-15 for grade application and replenishment interval (4) Use oil as prescribed in item 1 above (5) Fuel tank capacity (6) Fuel consumption per 8 hrs., continuous operation at full load
		10	9150-265-9435(2)	OE 30	5 qt	(3)	
		10	9150-265-9428(2)	OE 10	5 qt	(3)	
		10	9150-243-7603(2)	OES	5 qt	(3)	
2.	0304 AIR CLEANER			Oil, Lubricating (4)	3/4 qt		
3.	0306 FUEL TANK	10	9130-160-1818	91A, Gasoline, Automotive combat	20 gal (5)	26 gal (6)	
4.	1311 WHEEL ASSEMBLY GREASE FITTINGS	10	9150-190-0904	GAA, Grease, Automotive and Artillery, 1 pound can.	(3)	(3)	

BY ORDER OF THE SECRETARY OF THE ARMY:

G. H. DECKER,
General, United States Army,
Chief of Staff.

Official:

R. V. LEE,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

To be distributed in accordance with DA Form 12-7 requirements for TM 5 series (Uncl) plus the following formula:

DCSLOG (1)
USASA (2)
CNGB (1)
Tech Stf, DA (1) except CofEngrs (3)
USAABELCTBD (2)
USARADCOM (2)
USARADCOM Rgn (2)
MDW (1)
Seventh US Army (2)
EUSA (2)
Corps (2)
Div (2)
Engr Bde (1)
USAES (100)
JBUSMC (1)
Units org Under fol TOE:
  5-48 (2)
  5-237 (5)
  5-262 (5)
  5-267 (1)
  5-278 (5)
  5-279 (2)

NG: None.

USAR Same as Active Army except allowance is one copy to each unit.

For explanation of abbreviations used, see AR 320-50.

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